

I PRO

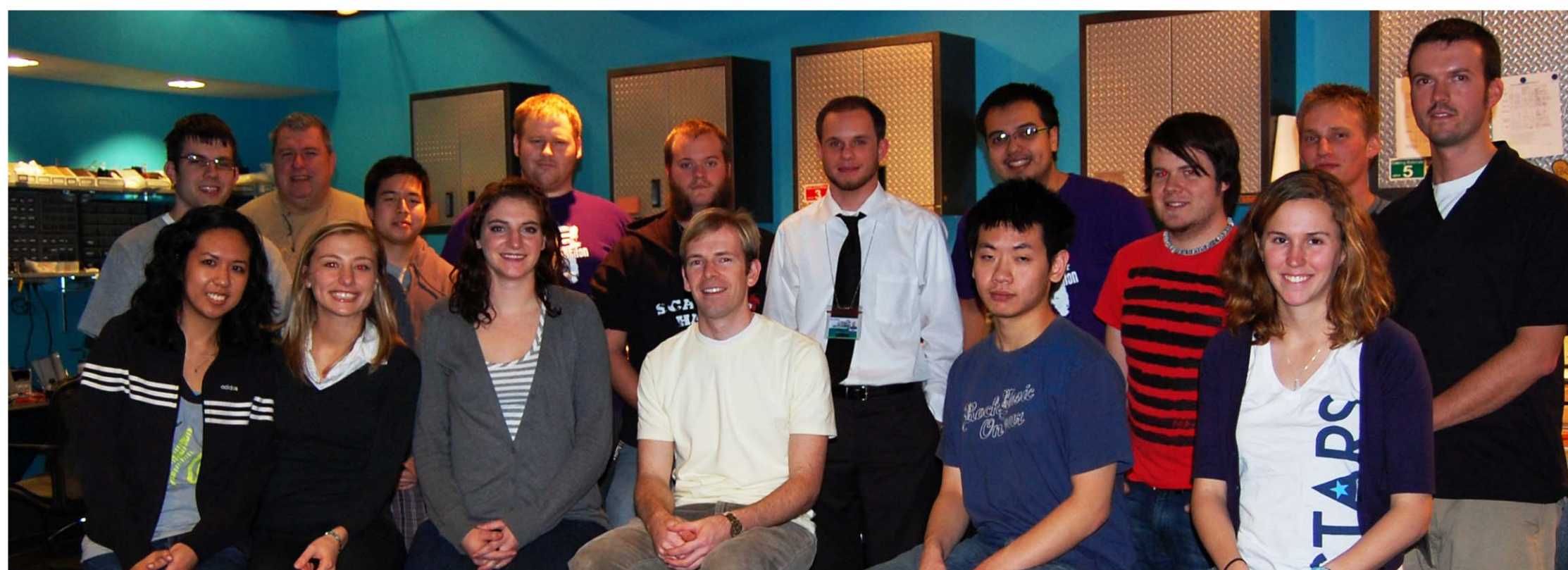
333

the Fab Lab:

MUSEUM
OF
SCIENCE
AND
INDUSTRY

Creating Design-to-Prototype Learning Modules at

Fall 2009



I-entists

Dream IIT **Design IIT** **Fabricate IIT**

Andy Bonesz | Andrew Clark | Carlie Douglas | Mike Gajdorus
Keenan Gottschall | Rachel Hendricks | Clayton Kimball | Diego Linares | Paul Marks
James Mellom | Cindy Oblenida | Sabina Pop | Carl Stelcel | Jeremy Young | Raymond Zhou
Dr. David Gatchell | Professor Blake Davis

The Fab Lab | The I PRO

Fabrication Laboratories, or Fab Labs, were started as a community outreach program by the Massachusetts Institute of Technology and the Center for Bits and Atoms. The first Fab Lab grew out of the popular MIT class MAS 863 "How To Make (Almost) Anything." Since then, the Fab Lab community has grown to 35 fully capable labs worldwide including one mobile Fab Lab, with another 26 planned -- one of which is opening in January 2010 at the University of Illinois, Urbana - Champaign.

Fab Labs provide digital fabrication tools for rapid prototyping to the general public. Each lab is geared toward helping its community by providing a product or service. The Museum of Science and Industry has partnered with I PRO 333 to further develop the Fab Lab at their site.

I PRO 333 currently works with the administration in the Fab lab at MSI to design materials and activities for increasing the use of the laboratory. We aim to broaden the possible uses of the lab, promote membership at the museum, and increase the community's participation in science and technology programs at the museum.

In order to accomplish our goals I PRO 333 divided into three teams, each of which focused on different aspects of the lab.

The Projects Team's goals included designing and creating new projects, tutorials, and activities for users of the Fab Lab, principally 4th – 12th grade students. These projects are meant to be fun as well as educational.

The Organization Team's responsibilities include taking an inventory of the equipment and materials, organizing and cleaning, machine maintenance, and creating safety guidelines and machine tutorials for the lab. Creating a user-friendly lab is key in a museum setting.

The Marketing Team was in charge of marketing the Fab Lab; disseminating information about the lab to museum figureheads, and employees within, and volunteers and community members outside of the museum. In doing this, I PRO 333 began promoting the lab's presence within the community.



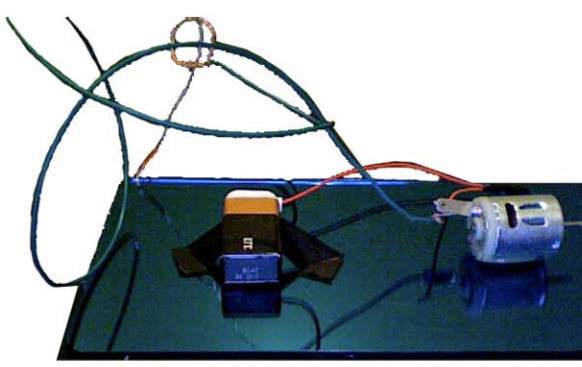
Projects

Project Design Process

In creating a project that is both rich in fun and educational value, a functional team requires research, creativity, and expertise from multiple disciplines in order to be successful. IPRO 333's dedicated projects team implemented the following strategies:

- Become familiar with the Illinois Math and Science Standards that area schools follow
- Brainstorm potential projects that would meet the criteria so that each project could be used as an educational tool
- Decide which projects are feasible to build in the Fab Lab
- Learn how to use the various Fab Lab machines needed to create project
- Finalize design and begin manufacturing prototypes
- Use of economical material such as cardboard allowed flaws to be fixed easily and cheaply.
- After the completion of a successful prototype, choose a material that is effective in the design and usable in the Fab Lab
- Allow others to create the project with ease by designing a tutorial
- Test the project and tutorial on others and use feedback to improve the design process

Created Projects

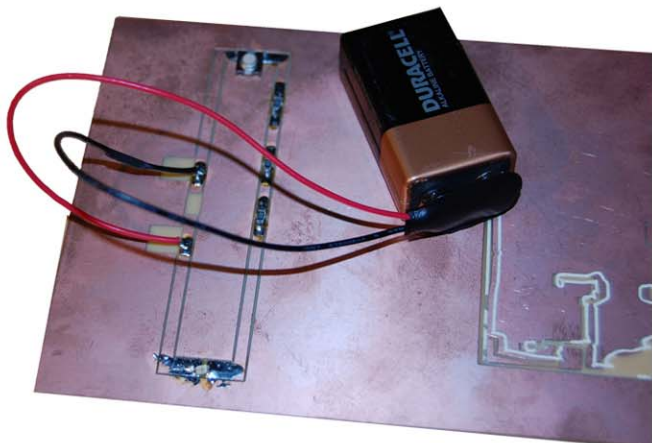
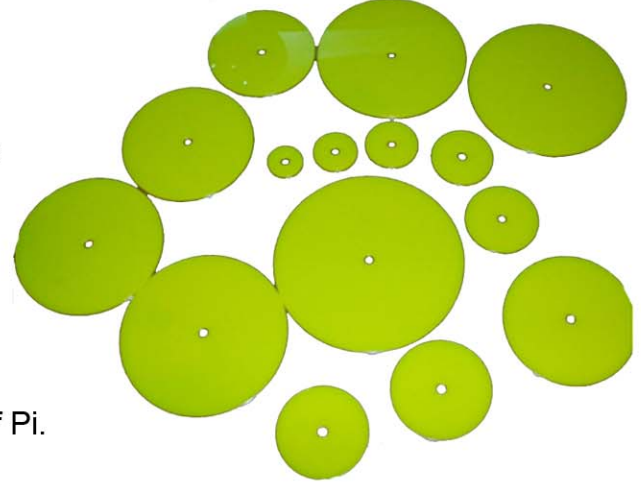


The Loop Game Raymond Zhou Senior Electrical Engineer

The Loop Game is a game that involves moving a metal loop along a path made from a length of wire without touching the wire. They are connected to a 9 volt battery and a DC motor in a way that, if they touch, they will form a closed circuit causing the DC motor to start vibrating, indicating that the player has lost.

Discovery of Pi Jered "Diego" Linares Senior Biomedical Engineer / Computer Science

The Discovery of Pi project will allow students to gain an empirical understanding of the origins of Pi. The project is designed for students in grades 6 to 9. Pi is a constant used heavily throughout every level of engineering and mathematics both in industry and academia. Through a better understanding of Pi's origin, the students will gain a more intuitive use of the constant. The project allows the students to use Corel Draw to create various sized circles then use a laser cutter to fabricate those circles. By measuring the circumference and diameter of each circle and calculating the ratio, the students gain an intuitive understanding of Pi.



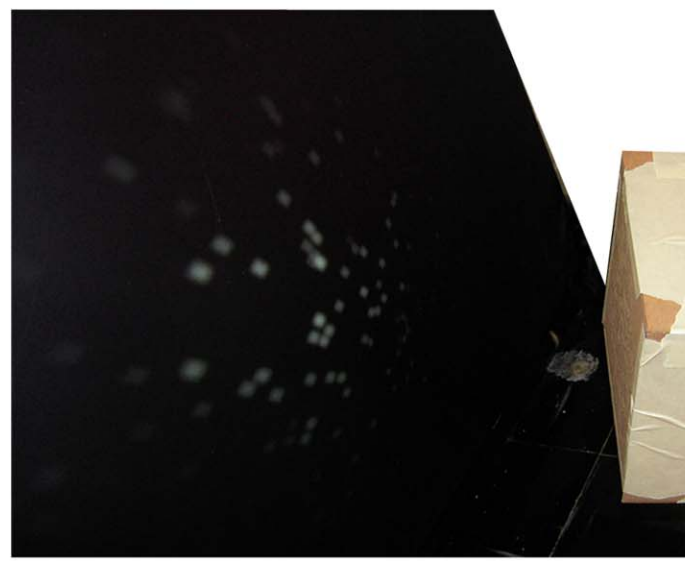
LED Circuit Jered "Diego" Linares Senior Biomedical Engineer / Computer Science

The LED Circuit is targeted for students in grades 9 to 12 and introduces the concepts of circuit analysis from a real world perspective. This project utilizes a Modela milling machine which isolates a circuit on a conductive surface. A switch, a power source, resistors, and an LED are then combined to create a simple circuit. The project will utilize Ohm's Law along with Kirchhoff's voltage law to allow students to understand how each component affects the circuit.

Game Template & Catapult Howard "Andrew" Clark 5th Year Senior Architecture

Based on the works of the project mastermind Rube Goldberg, the game template allows the student to come up with a trivial based, maze type game and see the outcome of the design process involved in its creation. Two rings or hooks placed at the top corners suspend a string tied to a medium that allows for the precarious placement of a ball bearing. When maneuvered properly along a predetermined path the objective can be either placement or avoidance of the holes located throughout.

With the intent of mocking up a Rube Goldberg device, a catapult was created. This would have initiated the series of events that would have taken place.



Personal Planetarium Jeremy Young Senior Biomedical Engineer

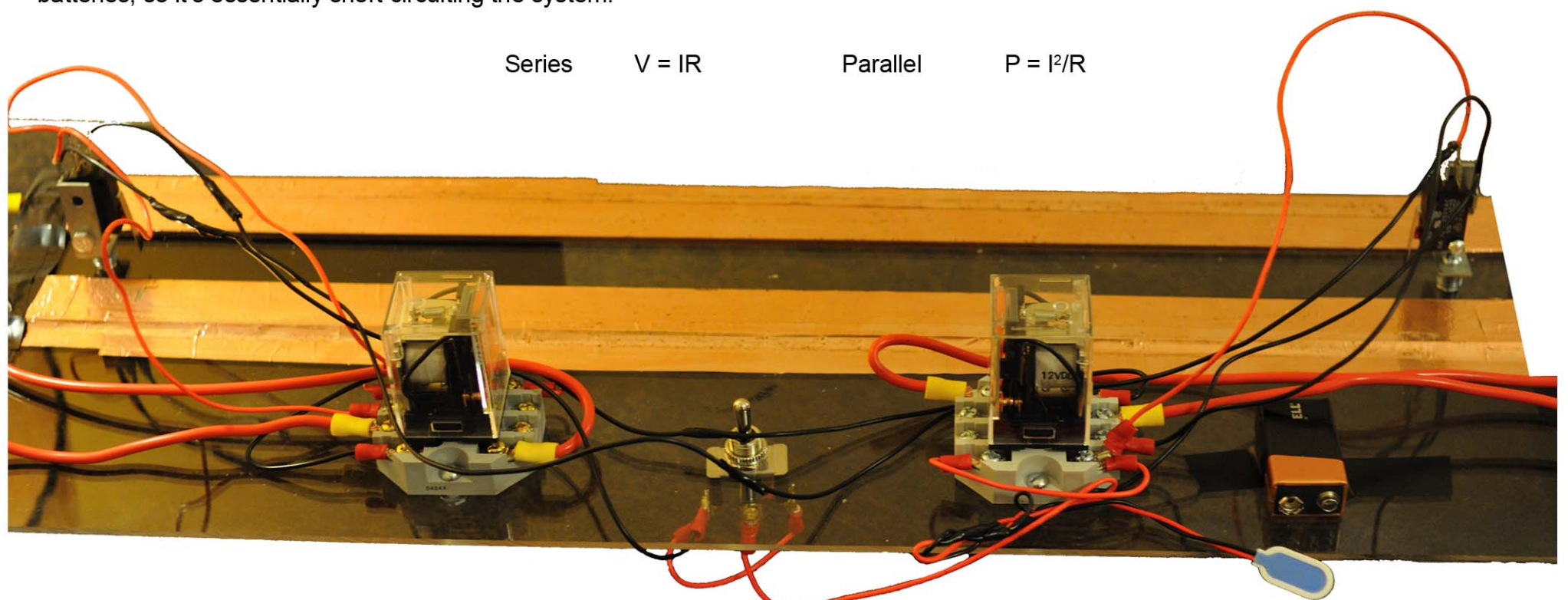
Light pollution and cloudy skies may block your view of the stars outside, but with this personal planetarium you can check out the constellations in the convenience of your own room. Just turn out the lights and enjoy the show. Impress your friends with your knowledge of Cassiopeia, Andromeda, and Perseus. This project is specifically designed to help students fill the Illinois Science Standard 12.F.2c which states that late elementary school students should be able to "identify easily recognizable star patterns (i.e. the Big Dipper, Orion, and other constellations)." The Chicago area does not have a great view of the sky due to light pollution so as an alternative to just looking at pictures, this is a more realistic option.

The Railgun Project Paul Marks Senior Biology

The Railgun project is essentially two rail guns firing a projectile at each other. The system entails copper rails, wiring, relays, microswitches, and a metal shaft with magnetic spheres. It is setup so that once turned on the one side consisting of four 12 volt batteries wired in parallel will have a completed circuit by the projectile laying across the two copper rails. This creates a force, which in the current orientation, rolls the projectile away from the edge down the rails. Once it reaches the other edge it bumps into the microswitch. This sends a signal to the relays which effectively turns off the battery source and turns on the opposite battery source wired in series. This sends the projectile back from where it came. Here it also hits a microswitch, and the process repeats itself until the entire system is turned off.

The Fab Lab was utilized in the creation of the acrylic base and the soldering for the wiring of the entire system. The copper rails were cut using the vinyl cutter. Educationally, the theory of a railgun is a current loop creating a magnetic field around the rails. This magnetic field is thus creating the force. The projectile is needed because it is actually what completes the circuit. The circuit is completed by going back into the batteries, so it's essentially short circuiting the system.

Series $V = IR$ Parallel $P = I^2/R$



Organization

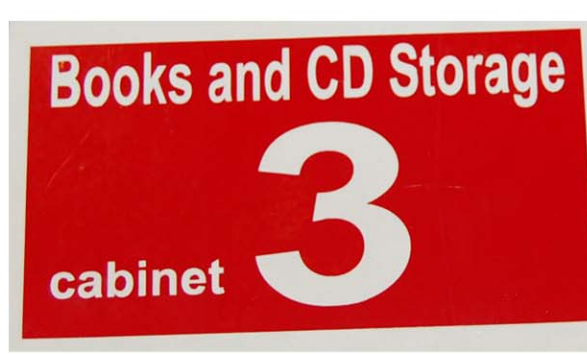
Organizing a Fab Lab

Inventory

Upon entering the Museum of Science and Industry Fab Lab, IPRO 333 was met with many major problems regarding organization and safety -- two elements crucial to any lab. The lab was first inventoried. A record of all the materials and equipment in the Fab Lab was created. This inventory count is currently in the process of being imported into a freeware digital inventory system.

Reorganization and Labeling

Once the lab was inventoried, methodical reorganization took place. Materials, supplies, and tools were relocated near the machines in which they serviced. Scrap materials determined to be usable were relocated to a single pile while scraps deemed unusable were thrown away. Labels were created for each cabinet with its proper contents. The labels were created using many of the machines in the Fab lab and were meant to show through materiality the content of the cabinet.



Machine Maintenance & Manual Implementation

Upon IPRO 333's arrival to the Fab Lab, multiple machines were either broken down or in bad condition. With a consultation from IIT's Material Lab manager, John Kriegshauser, we were educated on how a successful shop is run. Following John's advice of "take care of the machines and they will take care of you," we located the user manuals for each machine in the lab, and printed hard copies that are now stored in the lab.

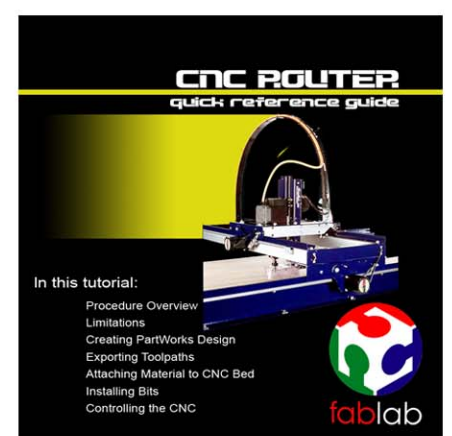
Safety & Signage

Safety is a vital part to any lab. Unfortunately, the Fab Lab lacked general safety policies for the lab as a whole as well as specific guidelines on how to safely use each machine. To address this, we studied not only each machine's manual to find the recommended safety procedures, but other labs and model shops as well. Signage was created to explain to the user what each machine does, how it should be used, and the proper safety precautions that should be taken specifically with that machine. Keeping with the museum's theme, the signs were created with a uniform design, to give the lab the feel of a museum exhibit.

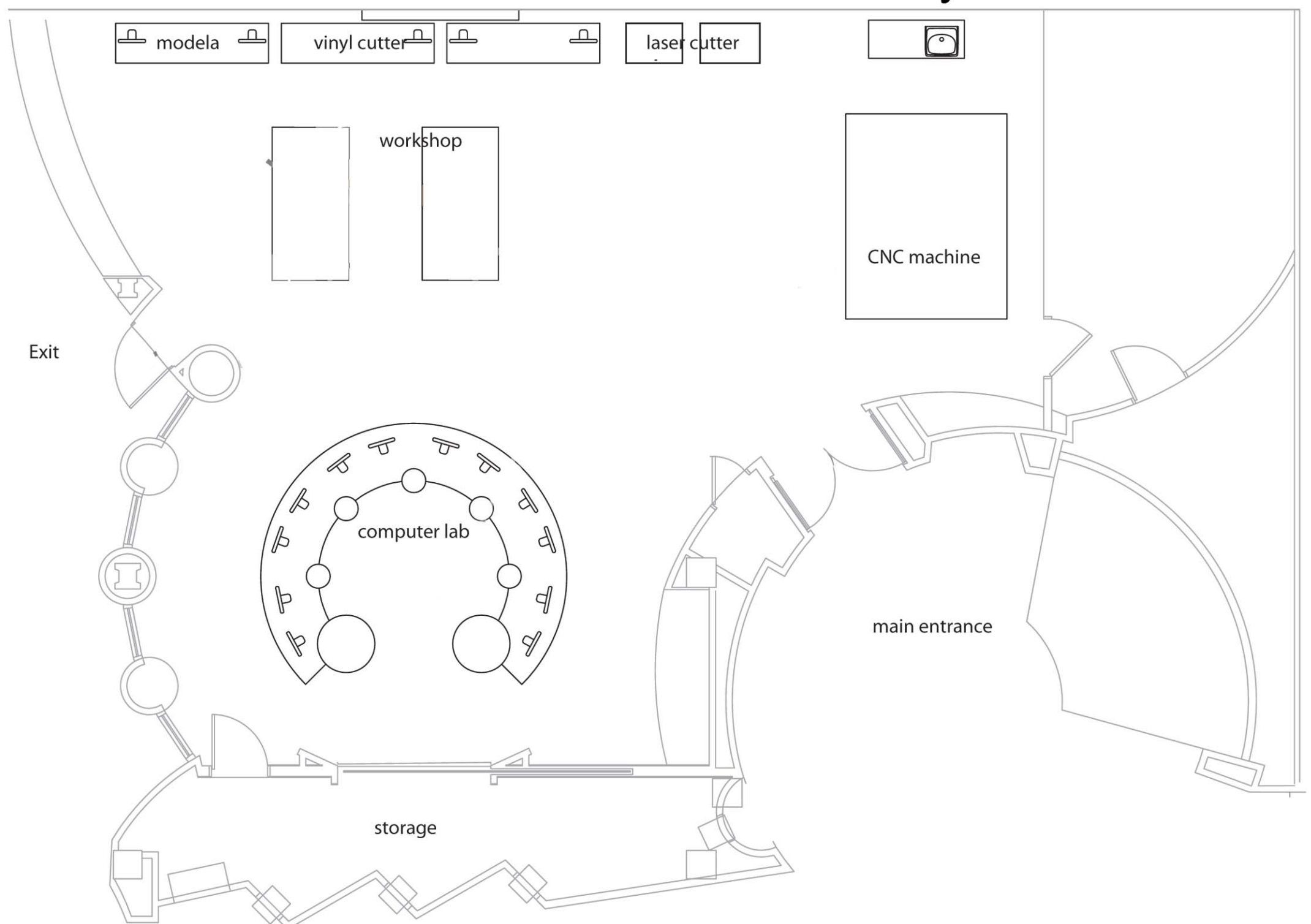


Machine Tutorials

Reading through the manuals that come with these machines is not the ideal way for a Fab Lab user to spend their time. Fortunately for them, through the studying of user manuals, and experience with the machines, IPRO 333 did the dirty work. Each of the machines now has a short tutorial that can teach the user the basics of each machine in about 15 pages. These are by no means a substitute to the full manual, but they will get the novice user acquainted with the machines and have them up and running with ease.



The Museum of Science and Industry Fab Lab



Marketing

The purpose of the Marketing sub-group is to generate public interest and awareness of the Fab Lab. The Fab Lab was not being used to its full potential.

Organization & Approach

IPRO 333 targeted a wide range of potential users with the following strategies:

Reach out to organizations, associations, artists, hobby and craft clubs

With the help of the museum's Center for Ethics, accessed the Associations Unlimited database and reached out to organizations, associations, artists, hobby and craft clubs

Selected the scope of associations by choosing organizations in Illinois relating to:

- Engineering
- Technological Science
- Natural Science
- Social Science

Organized the contact information of 100 associations

Sent each a letter and brochure about the Fab Lab

Created ipro333f09@iit.edu to correspond with potential user groups

Received a response from Bill Higgins of Fermilab (Chicago Space Frontier Society)

He is interested in visiting the Fab Lab with his colleagues

At this time, an open house is being coordinated for Fermilab

Name of association	
Audio Engineering Society	Classic Car Club of America
Audio Engineering Society, Columbia	Convar Society of America
Central Illinois Apple and Macintosh Users	Early Haulers Chevy Truck Club
Chicago 1st Black Inventors/Entrepreneurs	Ford/Ford Collectors Association
Chicago Space Frontier Society	Gateway Decorative Artists
Experimental Aircraft Association	Gems of the Prairie Quilt Guild
Fox Valley Electric Auto Association	Greater Chicago Classic Chevy Club
Aeronautica and AirLabel Collectors Club	Greater Chicago Insulator Club
IEEE Control Systems Society	Greater Midwest Rotorcraft
IEEE Electron Devices Society	Harsh Waters Volkswagen Club
Illinois Innovators and Investors	Hearth n Hands Quilt Guild
American Bugatti Club	Historical Miniatures Gaming Society
American MGB Association	Hunt/Club of America
American Truck Historical Society	Illinois Chapter National Corvette Restorers
Antique Automobile Club of America	International Harvester Collectors
Illinois Renewable Energy Association	International Harvester Collectors Club
Illinois Solar Energy Association	International Mercury Owners Association
Illini Space Development Society	Maverick/Comet Club International
Optical Society of Chicago	McHenry County Historical Society
Popular Astronomy Club	Mid-Century Mercury Car Club
Society for Amateur Scientists	Mid-West Corvette Club
Society of Physics Students	Midwest Deoxy Collectors Association
American Society for Engineering	Miniature Arms Collectors/Makers Society
Committee on Capacity Building Science	Minute Breakers Model Boat Club
Environmental Education Association of	Nash Car Club of America
Illinois Association for Gifted Children	National Aeronautics Association
Illinois Science Education Leadership	National Association of Miniature
Illinois Space Society	National Association of Rocketry
Antique Caterpillar Machinery Owners Club	Northern Illinois Corvette Club
Illinois Technology Student Association	North Area Miniature Society
Mid-Western Educational Research	Piquette Collectors Club
Technology Education Association of	Puppeteers of America
Antique Automobile Club of America	Quad Cities British Auto Club
Antique Motorcycle Club of America	Quarter Century Wireless Association
Bead Society of Greater Chicago	Salt Creek Quilters Guild
Craftsmen and Collectors Association of	Short Wing Piper Club
Central Electric Railfans' Association	Society for the Preservation and
Chevy and Geo Club	St. Louis Rotorcraft Club
Chicago Norton Owners Club	Stockbaker Driver's Club
	United Federation of Doll Clubs
	Volkswagen Club of America
	Vintage Volkswagen Club of America
	Walt Disney Collectors Society
	Wee 'n' Mini Club

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Mr. Jeff [redacted]
Vice Chairman
Audio Engineering Society
Shure Inc.
[redacted]
Niles, IL 60714

October 15, 2009

Dear Mr. Segota,

IPRO 333, an interprofessional project team from the Illinois Institute of Technology, would like to extend an invitation to visit the Fab Lab (short for Fabrication Laboratory) at the Museum of Science and Industry, Chicago.

The Fab Lab at the Museum of Science and Industry is one of thirty-four labs across the world. Through everyday use, Fab Labs have evolved into a community outreach program that encourages entrepreneurs to take their ideas from simple ambition to reality. In short, a fabrication laboratory is an open access workshop that houses digital fabrication equipment for rapid prototyping. The concept of a Fab Lab is to provide the general public with tools used typically in product development. Please see attached brochure for a more detailed description of the Fab Lab at the museum.

In collaboration with the Museum of Science and Industry, the mission of our team includes to increase public awareness of the Fab Lab and to establish a market of knowledgeable users. Therefore, a open call to associations, organizations, clubs, creative and innovative minds around the Chicagoland area is being issued to allow us present the mechanics of the Fab Lab and discover ways of working together. Consider attending one of our open house sessions at the Fab Lab, which includes a tour, overview of the equipment, and hands-on activities.

We would greatly appreciate your participation in our project. Please feel free to contact us with any questions.

Sincerely,
Cindy Oblenida & Sabina Pop
Members of IPRO 333, Fall 2009

IPRO 333 MSI-entists

Fabrication Laboratory at the
Museum of Science and Industry, Chicago



fablab

Team Members

Andrew Bonecz	Paul Marks
Howard Clark	James Mellom
Carlie Douglas	Cindy Oblenida
Michael Gajdos	Sabina Pop
Keenan Gottschall	Carl Stelcoi
Rachel Hendricks	Jeremy Young
Clayton Kimball	Raymond Zhou
Jered Linares	

Faculty Advisors

Blake Davis
David Gatchell

Midwest Fab | ah Network Symposium

On November 5, 2009, members of IPRO 333 received the opportunity to participate in the Midwest Fab Lab Network Symposium in Appleton, Wisconsin. The trip offered a better understanding of the concept of a Fab Lab and its network.

The trip to Appleton was an inspiring and eye-opening experience. We learned of the importance of networking through the Fab Lab and how the Fab Lab is an open source platform of knowledge that is shared globally. In terms of sustainability, we discovered that each Fab Lab creates its own business model that adapts to its community and environment.



Professor Blake Davis speaking at the MFLNS



A Weekend of Presentations: The MFLNS had numerous presentations - even during lunch breaks - that educated and informed representatives from 25 Fab Labs throughout the United States



Team members Cindy Oblenida & Sabina Pop attending the MFLNS and visiting our Fab Lab neighbors at the Fox Valley Technical College in Appleton, Wisconsin.

Welcome to the Fab Lab: The Video

Members of IPRO 333's Marketing sub-group with video expertise suggested making a short marketing film about the Fab Lab.

Making the Video:

First, an outline was created to capture the essence of what the video should be

Next, the outline was turned into a storyboard

After deciding on the general content, footage was shot in the Fab Lab

Add in a script and audio track, with some post-production

We have a video

Please take a moment and view our video on display

Summary

Successes

- Expanded the size of target market
- Contacted other Fab Labs around the nation through the Polycom video conferencing
- Good teamwork including communication, coordination, and organization of tasks
- Detailed documentation of accomplishments to serve as a resource for future IPROs
- Communication with overall team on sub-group progress and goals through Powerpoint presentation and one-on-one interaction
- Team building activity, bowling at the BOG, to improve rapport of overall team

Recommendations for the Future (EnPRO 353)

- Research the work of past Fab Lab IPRO's to build upon past rather than repeating it.
- At the start of the semester, take a look at resources from the MFLN Symposium
- More aggressive marketing strategies
- Follow up on associations and organizations that we contacted
- Create business plan and present to Museum of Science and Industry (Fab Lab Advisory Board)
- Certification and training program
- Continue to network among Fab Labs across the nation and world