SPRING 2010

UIUC IEEE MAGAZINE

SPARK

SNEAK PEAK

New ECE Building!

WHAT'S DEVELOPING?

Students lead MyCampus, Chromatactix, and IEEE touch screen projects

ALL NEW!

First ever edition of The Spark!

Greetings My Fellow Engineers,

I would like to present to you the first issue of IEEE's *The Spark* magazine. *The Spark* is a technical magazine dedicated to student projects from all disciplines of engineering. Our first issue includes articles from the American Computing Machines, the Undergraduate Materials Organization, the Jerry Sander's Robotics Team, the Biomedical Engineering Society, Bridge to China, and Illinois Space Balloon. Among the other features in this magazine, you will find a how to section, an interview with a professor, and some fun pages for entertainment. I would like to take this opportunity to recognize the members of the Internal Task Force of IEEE—Sujeeth Bharadwaj, Nancy Chang, Graham Heimberg, Glen Xi, Julie Bai, and Wolfgang Rubrecht—who have put in a great deal of time to create this magazine.

Sincerely,

Mahir Gosalia

Mahir Gosalia
Internal Vice President of IEEE

Spring 10
Contents

Interview with ECE Professor Pete Sauer

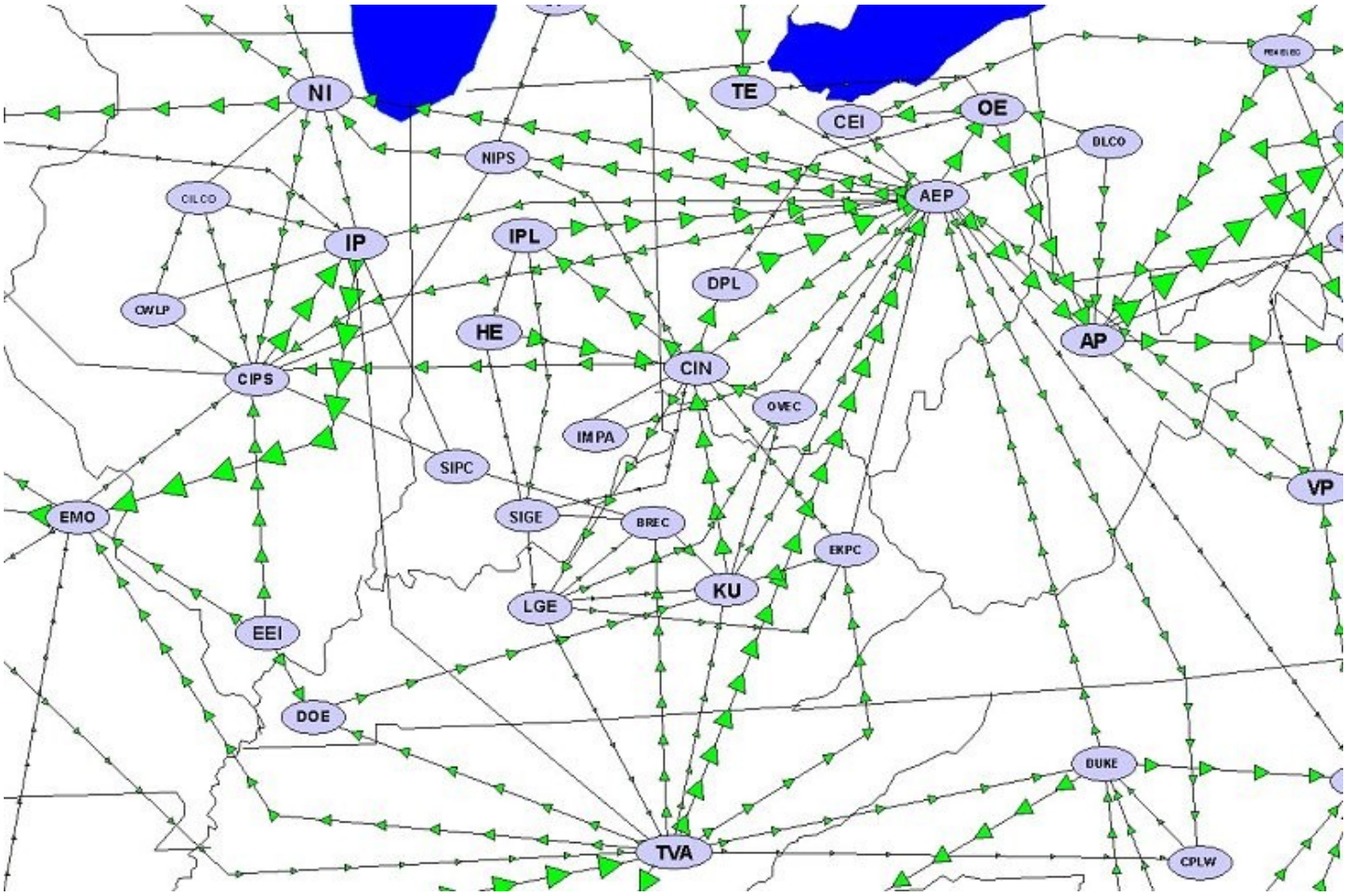
A typical ECE student at the University of Illinois spends approximately five hours a week with each professor – that's more than the average time we spend with our family! But do we really know our professors as well as we should? In this short interview, we hope to share a few things about Professor Pete Sauer—things he may not have mentioned in his classes, office hours, or anywhere else.

Born in Minnesota and raised in St. Louis, Pete Sauer's early years weren't very different from other Midwestern kids. Sauer went to the University of Missouri at Rolla to get his BS in electrical engineering. It was there that he met his wife, Sylvia. Soon after, Sauer had the opportunity to serve his country. "I had an option to either go to Vietnam, carrying guns on the front line, or stay back at home designing electrical engineering related things." He chose the latter.
Upon return, Sauer spent another four years at Purdue University for graduate school and then finally settled here on campus at the U of I. Thirty-two years later and still working in the exact same office he started off in, Pete Sauer has dedicated years to the university and his students.

So what made you want to become an engineer?
"Well, my father was a Lutheran pastor and a professor of theology. I remember going to my high school counselor. He asked me what I wanted to be, and at that time, I wanted to be an electrician. So I told him so. 'You can't be an electrician,' he said. 'Your father's a Professor.' So since my father was a professor and not an engineer, I thought that since I didn't want to do what he did, I was going to become an engineer."

You have been teaching power for 32 years now. Why did you choose power as your concentration in electrical engineering?
"Nothing else other than power interests me—it's never going to go away and you can work wherever you want. It's an amazing time to be in the power business. However, there are some aspects of business that I don't like. I don't care about the distribution side of business–backyards, transformers, that kind of stuff. I like the modeling and simulation of large-scale grids, computer programming, and the ideas behind theory and optimization."

Power World has proven to be quite powerful and successful. Would you care to explain what Power World is to people who might not have heard of it before?
"Well, I helped start a company with Thomas Overbye, George Gross, and Mark Laufenberg on a project called PowerWorld. PowerWorld is a software that helps people visualize, interact, and analyze power systems. Initially, it started as a video game—to see who could go through one day with the lowest cost. It was more or less for fun and education. Now it's a serious commercial product."



So what do you do for fun around here?
"Mainly stuff at home. I enjoy fixing up the house. I rewired it all and had it air conditioned and painted a couple of times. Also put a pond in the yard too. I occasionally go up to Minnesota on vacation. Sometimes conferences can be fun too—meetings in Switzerland, Italy, Hawaii. There's a conference this coming January. Perfect time to get out of here to go to Hawaii and take a couple of days afterwards to goof off."

What has been your best experience on campus so far?
"Working with the Grainger Foundation. It all started when William Wallace Grainger visited the campus with his son David around 1980 and announced that their foundation would give us one million dollars for a Grainger Professorship. The Grainger foundation has been extremely important in my career and the history of the ECE department ever since. They funded the remodeling of the electric machinery lab, a new power electronics lab, the construction of the Engineering Library, and the remodeling of Engineering Hall. They endowed funds for power area graduate student fellowships, undergraduate and graduate power engineering student awards, the Center for Electrical Machines and Electromechanics (CEME) , and have recently started a program that provides $1,200 scholarships for incoming freshmen in ECE. "

Catch Pete Sauer in Rm. 337 Everitt Lab or attend his ECE 430 course next semester.

Bridge to China - Wu Zhi Qiao

Jake Zhao, Q Gou, Charles Li, Christine Padilla, Joe Janiczek

Ever dream of doing something big? Traveling abroad? How about using your engineering skills to plan, design, and build something that will help out a community for decades? Oh yeah—did I mention that you can do it all for class credit?

Come check out Wu Zhi Qiao (WZQ), a new Registered Student Organization. We are the first international chapter of the Hong Kong-headquartered charitable organization, committed to giving students opportunities to apply acquired knowledge in helping underprivileged villages overcome their toughest challenges. Each year WZQ pairs a Chinese Mainland university with a university from Hong Kong or the United States. The organization aims to build bridges in Chinese villages that are separated from the rest of their community by rivers. Current bridges in these villages, if any, are made of rock mounds and a few logs. These pose a huge safety hazard for villagers—especially children—who need to cross the river to see doctors, go to the market, or attend school. The situation worsens during the flood season, when the primitive bridges are washed away, stranding villagers for weeks, sometimes months.

Projects are conducted from preliminary surveying, to designing, to constructing the very last beam by students with the aid of professional mentors. Usually, two universities cooperate in a project. We are fully supported by WZQ as the first international chapter and advised by Professor Bruce Litchfield, Assistant Dean in the College of Engineering. We received our first project at the end of October and are partnered with Chongqing university, a well-known Chinese institute with prior WZQ experience. After conducting our preliminary survey this winter, over thirty students are working on the bridge design as part of a 3-credit hour class called Learning in Community (LINC).

WZQ is a rapidly growing organization that seeks members from all disciplines and backgrounds, with many open leadership positions. This is a great chance to develop your social and professional skills, have fun in a different culture, and help a community in need. Business students can join our business team to write plans for competitions, network with businesses to obtain sponsorships, and plan fund raisers. Engineering students can dive into the technical side to survey, design, and plan logistics. Architecture and arts majors are welcome to join the technical side to blend our designs with the local culture. Technical translators who are proficient in both English and Chinese are also needed. Again, all majors are welcome!

We are also seeking professional engineers to mentor us through the technical aspects of our project. If you know anyone with qualifications in the area of bridge building, please contact us. We greatly appreciate your help! ■

Bridge to China Footbridge Design Competition

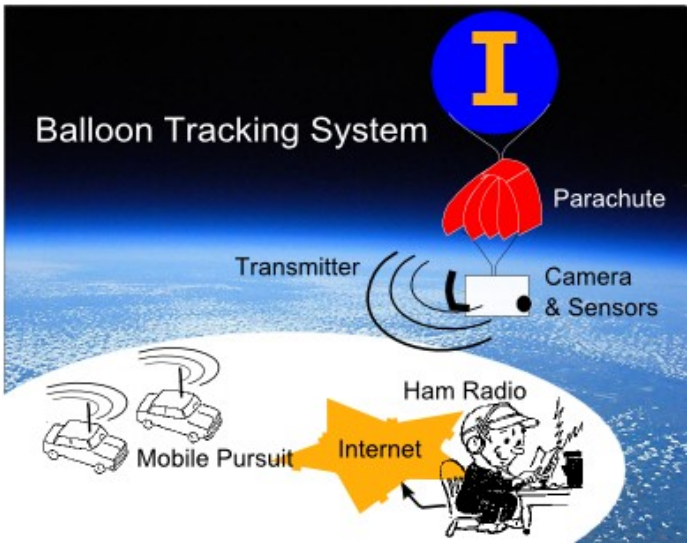
First Place* .....5,000 CNY ($732)
Second Place .....2,000 CNY ($293)
Third Place .....1,000 CNY ($147)
* Winners have opportunity to go to China to see bridge be implemented

Application Due .....March 15, 2010
Submission Due .....April 15, 2010
Undergraduate Teams 1-3

For Application Information & Additional Info Contact:
Ramya Amancharla amancha1@illinois.edu 217.979.7380

重庆大学 CHONGQING UNIVERSITY 無止橋慈善基金

It's a bird, it's a plane, it's a U of I Space Balloon? Yes, you might observe such a contraption in the coming months. It's the pet project of a group of us students trying to reach for the stars—or at least 100,000 ft—where we leave 99.9% of our familiar atmosphere behind in favor of the cold depths of space. From there you can look down and see the curvature of earth, feel the -50° C chill, and make radio contact with just about everybody. Looking up at night you have an undistorted view of the cosmos that rivals many space telescopes… and the best part? It's cheap!



Illinois has shot for space before but it hasn't always been easy. ION CubeSat—an Illinois program that launches small satellites into space under the guidance of Gary Swenson—has been using converted Russian ICBM's to get their gear off the ground. On one attempt, rocket failure within minutes of launch resulted in the destruction of all the CubeSats and a small crater on Russian soil. Bummer. But is there an easier way?

A rival group at MIT recently inspired us with their successful launch for under $150. They used a helium balloon along with a digital camera and a cell phone. It rose up into the edge of the stratosphere and eventually the low pressure burst the balloon. After descending to the ground, it sent an SMS with GPS coordinates so that they could recover their prize. They were rewarded with stunning photographs of earth on their first attempt. Of course luck plays a part. Using a cell phone requires cell coverage—and at such heights there isn't any. The group had to hope that their balloon would end up landing in a field with reception if they had any hope of getting it back. Hope they have Verizon.

That's why our attempt will use a radio transmitter for real-time tracking. We send our GPS coordinates every few seconds over the airwaves using a custom transmitter. Automatic Packet Reporting System—an interconnect of Amateur radio operators around the world linked via the internet—allows us to keep an eye on our balloon in real time so that we can follow in hot pursuit. The landing spot is constantly predicted in real time using weather information and relayed to ground team vehicles who are also tracking with radio receivers. This makes for a much more robust recovery with little additional expense.

But the sky is the limit and ultimately we would like to pursue grander goals. Duration of flight is one challenging contest, with record balloon flights lasting only 40 days. Because helium gas expands in the heat of day and contracts at night, current balloons have to vent helium to avoid bursting during the day, and cast off ballast to maintain altitude at night. Eventually the ballasts are used up. We are considering alternative systems—everything from solar-powered helium air compressors to bacteria-generated methane to create sustained flight. This allows for more complex experiments to be carried out on-board and greatly increases the scientific novelty.

We are encouraging student and community participation. Ham radio operators, engineers, and atmospheric science majors are particularly in demand, but if you have ideas or just want to help out in the chase we'd love it!

Our first attempt will be less ambitious and is slated for early March 2010. We will take photographs along with temperature and atmospheric measurements. We'll confirm that the earth is indeed round, space is black, and a group of nerds can track down a shredded balloon in an Indiana cornfield. It's one small step for engineers, one giant leap for U of I!*

By Martin McCormick

Those interested in helping out with this or future missions are encouraged to call (217) 953-0579 or email mmccorm3@illinois.edu

Want to see some balloon action now? Other balloon launches can be seen at www.eoss.org

* Ahead of MIT

How does APRS work?

APRS is transported over FM on the air using the AX.25 protocol at 1200 baud Bell 202 audio frequency-shift keying on frequencies located in the amateur radio 2-meter band (we use 144.390 MHz). An extensive digital repeater, or digipeater network provides transport for APRS packets on these frequencies. Internet gateway stations (IGates) connect the on-air APRS network to the APRS Internet System (APRS-IS), which serves as a worldwide backbone for APRS data. Also receivers can get obtain the messages directly using mobile radio receivers in their vehicle or at home. A number of LEOs (low-earth orbiting satellites) and the International Space Station are also capable of relaying APRS data.

Further information about the Automatic Packet Reporting System (APRS) is available at:www.aprs.org

Illinois iGEM 2009

A group of twenty University of Illinois students are packing their bags to attend a prestigious synthetic biology contest—The International competition for Genetically Engineered Machines (iGEM). Held annually at the Massachusetts Institute of Technology, this highly technical competition attracts over one hundred teams each year from various institutions. So what exactly are genetically engineered machines?

Due to recent advances in genetic sequencing and DNA synthesis, scientists can order custom sequences online. Such flexibility allows synthetic biologists to assemble genes in innovative ways, resulting in engineered cellular detection systems, protein outputs, and information processes. Although intriguing, these tasks are far from trivial; synthetic biology projects have been increasing in complexity over the last ten years, and require an understanding of several other areas such as electrical engineering, computer science, and mathematics. These fields provide a much more rigorous framework, commonly referred to as genetic circuits in the academic community. Heralded to provide solutions for alternative energies, medicinal therapies, and much more, synthetic biologists have received millions in grants. As a result, several developments have occurred; in fact, researchers have gone as far as creating bacteria to produce artemisinin, a substance that is used to cure malaria.

In 2009, Graham Heimberg (junior in electrical engineering) and Palak Doshi (junior in bioengineering) formed two interdisciplinary teams. The "dry-lab" team is creating new software tools to make biology easier for an engineer, while the "wet-lab" team is using synthetic biology to create new functions within bacteria.

Members of the wet-lab team spent their summer in the Institute of Genomic Biology designing novel organisms. The goal was to engineer a genetic circuit to implement decoder function within E. coli. Decoders are frequently used logic devices in low-level computer architecture. We are designing a 2 to 4 decoder, which takes two binary inputs to activate one of four outputs. With the presence of lactose and arabinose, our Bacterial Decoder will express Green Fluorescent Protein. If only lactose is present, a different fluorescent protein will be expressed. This goes for the other two combinations as well (only arabinose, or neither sugars). To implement logic, we use combinations of small non-coding RNAs and transcription factors. This system will allow scientists to swap standard parts in and out, making it highly compatible for a wide range of applications. Our Bacterial Decoder can sense multiple environmental cues, having implications for medical diagnostics and environmental and water contaminant detection.

Last year, a new category, software tools, was added to the competition. Teams were required to create a software tool for use with the standard biological parts. The University of Illinois has formed its first software tools team to participate in the October 2009 competition. Our project, Interactive Metabolic Pathway Tools (IMP Tools), creates new metabolic pathways using the known characteristics of existing pathways. The program takes a user-defined input compound (e.g. environmental toxins), output compound (e.g. value-added industrial products), and weighting scheme to determine the ideal enzyme cata

lyze each reaction, the genes that code each enzyme, and the overall stochiometric matrix of the reaction. This program will allow future scientists to apply important processes to various applications, ranging from bioremediation to biofuels.

To learn more about the teams you can visit their wiki pages at
http://2009.igem.org/Team:Illinois (wet-lab)
http://2009.igem.org/Team:Illinois-Tools (dry-lab)

Come next winter,

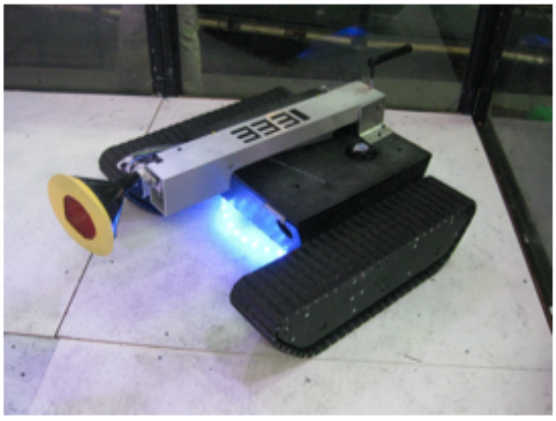
a new team will be in the works, so if you are interested in learning more about iGEM at Illinois feel free to contact:
Graham Heimberg (gheimbe2@illinois.edu)or Palak Doshi (pcdoshi2@illinois.edu).

Our research has been made possible by many departments and institutions on campus including the Institute of Genomic Biology, College of Engineering, college for Agricultural and Consumer Economics, as well as the Office of the Vice Chancellor for research.

ENGINEERING OPEN HOUSE PROJECTS of FALL 2009

JERRY SANDERS DESIGN COMPETITION

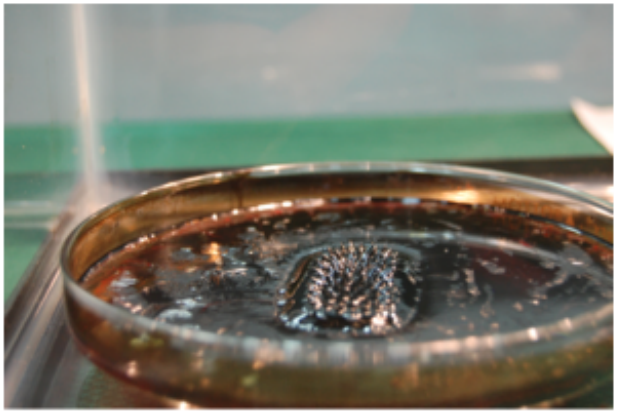
By: Brad Knicker



A fully autonomous unmanned aerial vehicle (UAV) makes its way into Iraq to shoot down tanks with utmost precision. These beasts are employed with cutting edge sensors, communication systems, and signal processing algorithms. The life of a Jerry Sanders contestant is almost, but not quite like that of a UAV designer. Held annually at the Kenny Gym, the Jerry Sanders Design Competition (JSDC) challenges student teams to build robots that meet certain requirements. These get progressively harder, ranging from moving around a track to playing tic-tac-toe with weighted balloons, to shooting down targets in the air (UAV?). Regardless of the difficulty, these design challenges require quick decisions, and more importantly, teamwork. At the end of the day, all participants feel excited and proud to showcase their babies at the Engineering Open House (EOH).

FERROFLUIDS

By: Trenz Pruca



If you were a nerd in high school and now an engineering student at U of I, you've probably seen Mythbusters before. Yes, they verify the validity of myths. In one of these episodes, they tried to see if ninjas could walk on water - well, sadly enough, they can't. As an aside though, they showed that it is possible to walk on water mixed with cornstarch. This inspired us to do something similar – hammer a nail on a piece of floating wood. We found a new material to experiment with– ferrofluid. When exposed to magnets, it is possible to move the liquid in lumps. It was particularly rewarding to demonstrate these properties at Engineering Open House (EOH) since we could educate the visitors about the wide range of applications, which include the use of cornstarch in advanced body armor and the use of ferrofluid in washing machines.

BMES

Biomedical Engineering Society

Engineering Tomorrow's Medicine Today

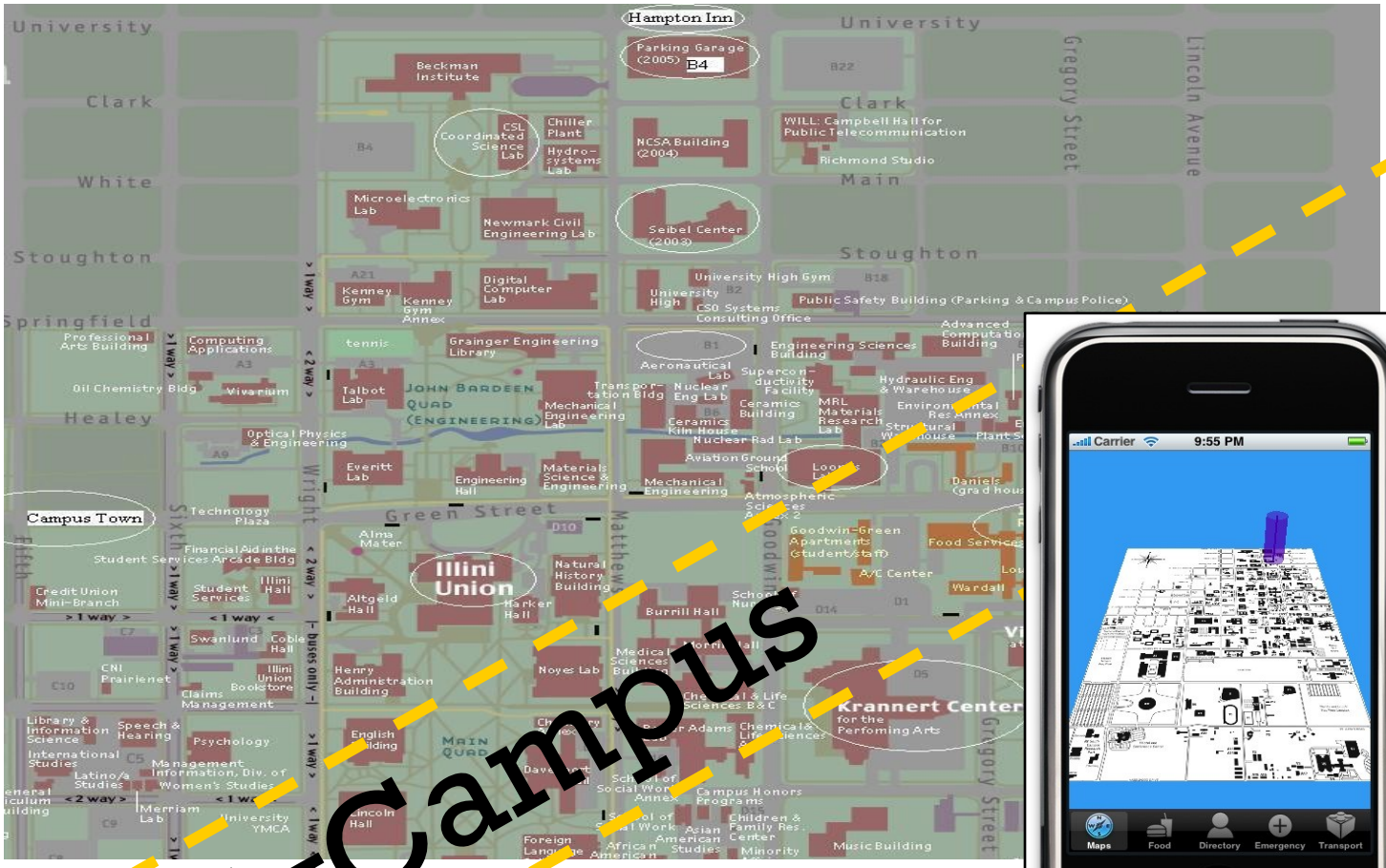
By Pratik Randeria

Bioengineering not only aims at curing and preventing disease, but attempts to limit medical expenses throughout the health care field. We as a society are attempting to bring today's breaking-edge technology to a wider consumer base. Current technology has created emergency medical training dummies that can provide physiological feedback to mimic a trauma patient.

The only current drawback of these systems is the high cost of ownership and operation. They require extremely specialized hardware elements and proprietary software to analyze the dummies' biological outputs. These systems currently range in cost from 3000 to 5000 dollars. Budgetary constraints leave many medical response teams (i.e. EMT, Fire and Rescue, and Hospital Staff) without life like dummies to learn basic skills.

The largest cost of these device can be attributed to the electronic sensors and computational processing equipment required to analysis the data. Our team has addressed both these issues by using two novel approaches. Current cost of production for customized pressure and movement sensor needed for this project range from 50 to 100 a sensor. To Substitute for these sensors we have used a readily available component: the Nintendo Wii remote control. This provides the output we need in order to measure acceleration and direction of joints; allowing us to analyze and correct improper patient handling.

The use of the Wii remote led to extreme cost reduction with the computational processing equipment. Bluetooth wireless technology allows us to remove the computational hardware from within the dummy. The responsibility has now been placed on an open source program on very inexpensive computer hardware. We have hopes that this product will allow better training of medical response teams regardless of economic restrictions.



Development Team
Markus Schober
Ian Ferguson
Melisa Kudeki
Steve Moser
Bhargav Nookala
Alex Sikora
Joseph Subida

"Last Fall, no one knew anything about iPhone programming," said Kevin Cathey, chair of MacWarriors. "Now, we're developing a full application."

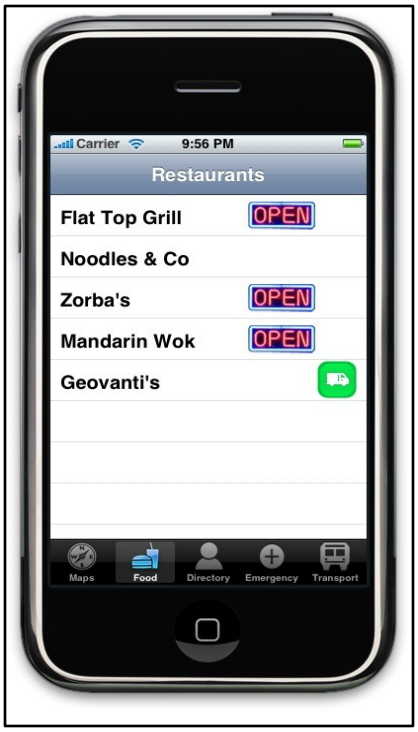
In August, 2008, it was a very exciting time to be in MacWarriors. Apple had released the Software Development Kit for the iPhone in March of 2008, allowing anyone to develop applications. Six months later, MacWarriors was eager to start the school year by getting in on the act. "It is always exciting to play with new technology, and iPhone developers are in demand, so we felt it was a good direction to follow," said Kevin. Cathey, himself an experienced Mac developer, was perfectly positioned to teach a new generation of MacWarriors how to write software for the iPhone, which uses many of the same frameworks as the Mac.

MacWarriors spent the first two meetings deciding what they wanted to make. "There were a lot of ideas," recalled Markus Schober, "and we decided, 'let's make something for campus'. After 'how tricky getting around campus is' was mentioned, we knew MyCampus was what we wanted to make."

"MyCampus is designed so that you can better understand the campus you spend your time on, all from your pocket," says the MacWarriors project description. MyCampus includes a detailed map of campus, a "phone book" for University of Illinois students and faculty, and information about bus routes and restaurants. "The application has several thousand lines of code," Markus explained. "So far it is working pretty well." This is especially impressive considering that Cathey was the only one who had programmed for the iPhone beforehand. "I didn't actually do any of the programming," said Cathey, "so this is all new to everyone working on the project. They're shaping up pretty well." What was it like going from knowing nothing to developing a full-blown application? "Well," Markus laughed, "It's been rather like building a sailboat. We began building the hull, but none of us knew how to sail at first, and the wind has been unpredictable, so it's been an interesting ride."

So how did they do it? "We spent the first five months training people," said Kevin. During the Fall '08 semester, Macwarriors gave several talks, seminars, and tutorials on how to program using the "Cocoa Touch" iPhone framework. Their training culminated the following semester with DevPhone, a weekend-long iPhone programming conference held by MacWarriors that attracted more than one hundred attendees.

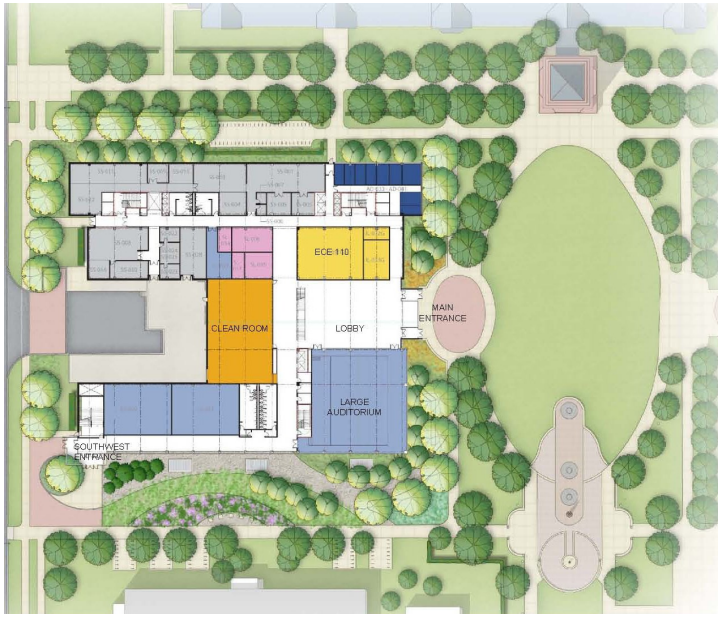
"The team started programming MyCampus around Thanksgiving," said Kevin. Since then, they've worked on adding maps, search functions, a GUI, and most importantly, made sure nothing breaks when they compile. "Every time we make a change, we make sure it still builds," said Markus, the lead developer. "And then we debug it." How far are they along? "Far enough to show it for [Engineering Open House]. We're concentrating on debugging the features we have- the map, the search, and the restaurants, a few buildings, and a bus route. We'll have something very nice to demo, but it definitely is not complete yet." MacWarriors plans to spend the Fall 2009 semester, and perhaps some of next as well perfecting the application. "We've come a long way, from zero to a working application," said Cathey. "Obviously, we're really proud of it."

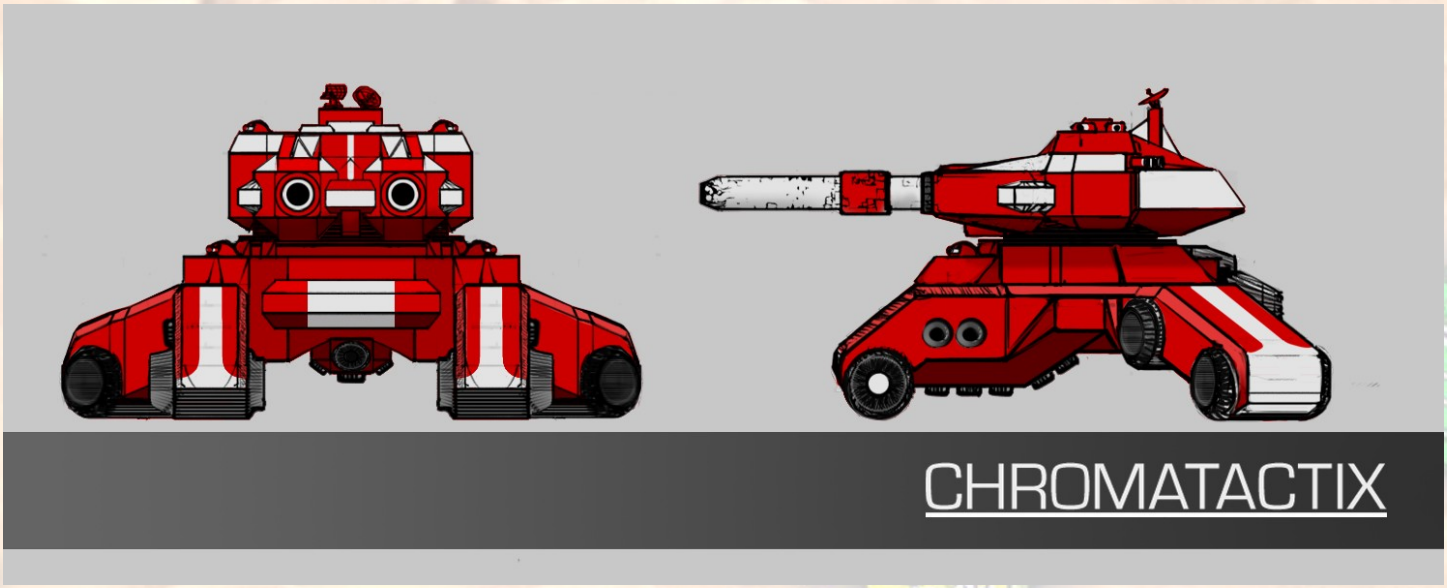


Finding your way around campus can be a tricky thing, especially if you're new. How do I get to this building? What restaurants are open at night? What bus do I take to get to my class on time? These questions often asked on campuses today. MacWarriors, a special interest group in the Computer Science department, has been hard at work developing an application to answer these questions. With MyCampus, an iPhone and iPod Touch application to be released late this year, you'll have a campus map and information about restaurants, events, and transportation wherever you go. MyCampus is an application built not only for the University of Illinois: it provides a framework that campuses across the country or globe can tap into with little effort. MyCampus is designed so that you can better understand the campus you spend your time on from the most convenient source: your pocket.

NEW ECE BUILDING

Fall 2013

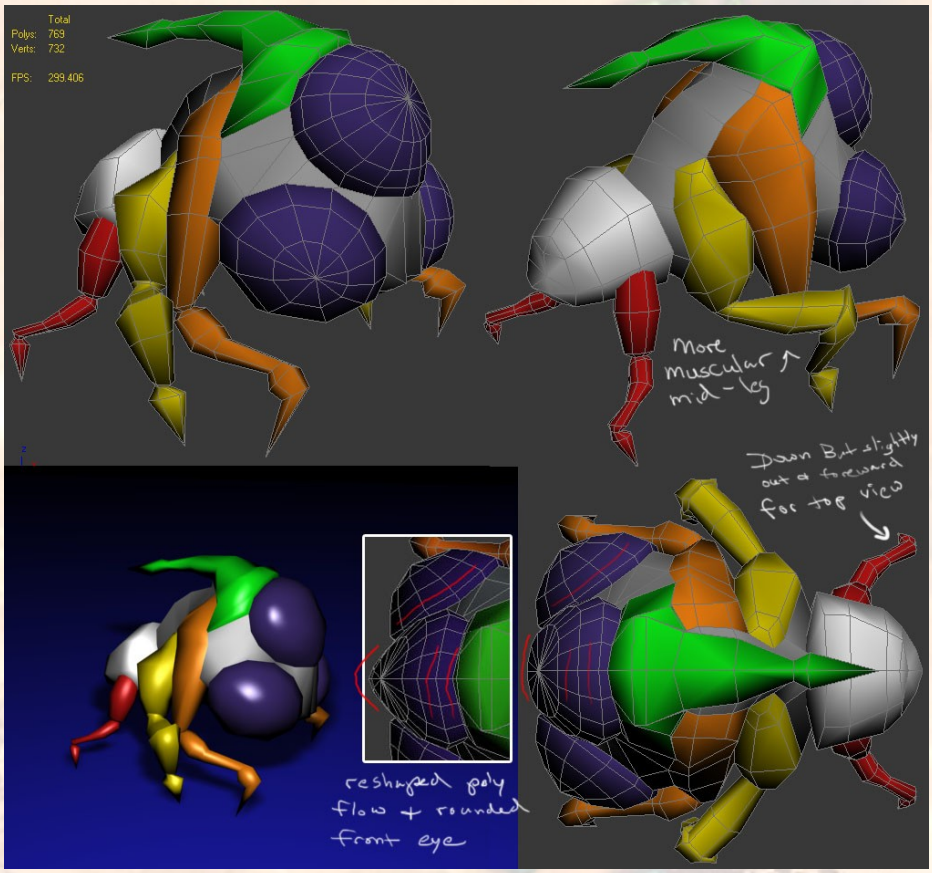




Chromatactix is a new and exciting game currently being developed by Gamebuilders. After the overwhelmingly positive feedback received at Engineering Open House, we have decided to develop the game for a national event, the Independent Gaming Festival, and also release it on Xbox Live Community Games Marketplace. Read on to find out more about what makes this game so popular…

The design stage of the game development process focused on fleshing out the features we wanted in the game and delegating work among the team. This took around two weeks. What inspired the team was a game called "Geometry Wars", originally released as an arcade game for the Xbox 360. Geometry Wars is known for its very fast paced gameplay similar to the old Atari arcade game called "Asteroids". Moved by the simple, yet engaging game-play of Geometry Wars, we wanted a game that was similar but also focused on teamwork. With this in mind, we designed a game that would have Color Coded Combat (C-Cubed). We envisioned a game that encouraged team synergy to excel. Each player controls a space ship that is associated with one of the four Xbox 360 controller colors (green, red, yellow, blue). Each ship is equipped with a laser cannon that shoots bullets associated with their color. Because the setting would be in outer space, you are obviously under constant attack by alien ships that also have a color associated with them. Players do the most damage to aliens of the same color. Therefore, if a player is red, he or she will do the most damage to red aliens. Now here's where the teamwork comes in – if a player gets hit by an alien ship of a different color, then that player's ship is obliterated from existence. This strategic game play encourages players to stick together – otherwise, they will not survive alone. We also discussed that we wanted our game to be challenging, yet welcoming to new and inexperienced players. Without limiting our audience in mind, we talked about simple, yet responsive controls, and also having varying difficulty modes. On a technical note, we wanted to have diverse and challenging artificial intelligence to keep the game fun and challenging. We wanted to have a sophisticated art design throughout the game by creating our own particle effects for collisions, explosions, and weapons. Furthermore, we wanted to have a full three-dimensional world to fight and explore in. Lastly, we wanted the game to have online capabilities so that players from all over the world could team up against the aliens.

The development stage of a game's life cycle focuses on actually implementing the features of the game discussed earlier. The C-Cubed Engine has been in development since mid September 2008, and will continue until November 2009, which is the deadline for the Independent Gaming Festival. The first three months (September to November) was spent learning the technologies we would be using to develop Chromatactix – mainly Microsoft's XNA Framework. The seniors on the team who had more experience in programming gave tutorials and shared tips and tricks with the less experiences members of the team. We also spent these months getting inspiration from other games, which built upon our previous design discussions. We also lost a member of our team during this time period. Because college is already extremely busy, you need to be motivated to take on such time consuming extracurricular projects. During the months from December to March we spent about 8 hours per week developing the C-Cubed Engine. We recruited a Sound Artist to cre-

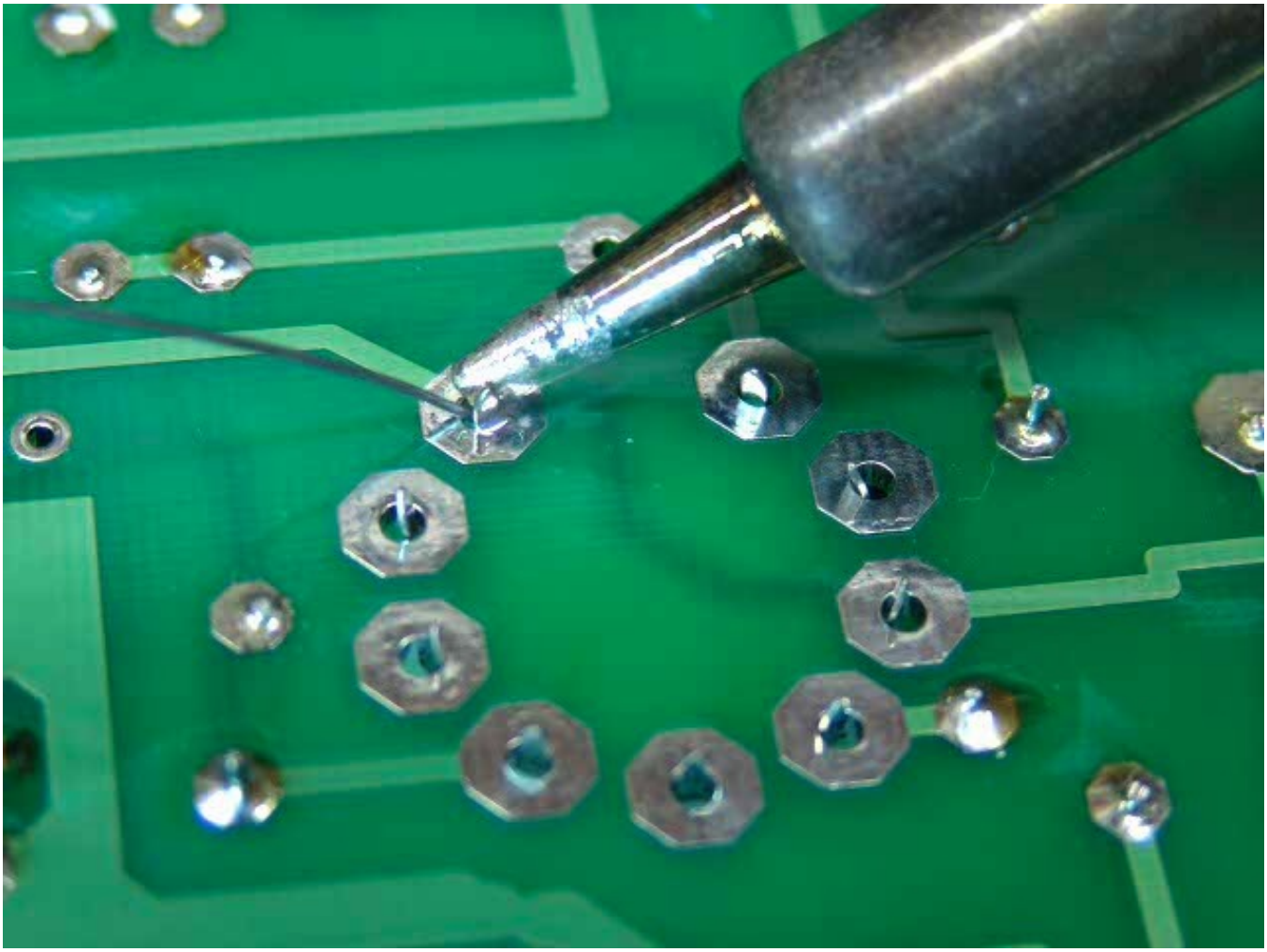


ate all of our music and sound assets. We created many of the art assets that make the game such as textures, 3D models, and particle effects. After working for a straight 12 hours the day and night before, we demoed the game on March 17th at the University's Engineering Open House. Our game received incredible feedback. Set up at the Siebel Center with a huge plasma TV, we had lines of people waiting to play our game. We even had a kid come back the second day with three of his friends to play the game. From a developer's point of view, this was an incredibly satisfying experience and made all of the long hours of development worthwhile.

Though the project was time consuming and challenging, we also had a lot of fun. One of the reasons our team was so successful was because we cooperated well together. We knew when to work hard, but we also knew when to play hard. We all developed close friendships over pizza while watching YouTube and the "Angry Video Game Nerd," which contributed to our development environment and culture.

Since most Gamebuilder teams develop their game for the Engineering Open House, the team usually stops meeting and the project is considered complete. However, based on the success of Engineering Open House, our team will continue to develop our game for the Independent Gaming Festival, which has a deadline of November 2009. We are happy with our game, but there is definitely room for improvement. We have plans to implement two different modes. One mode is an Adventure Mode where players will actually be able to explore different planets, instead of being restricted to the screen boundaries. Spherical Combat - the other mode - will change the gameplay from a rectangular map to actually visibly moving around a sphere. We just recruited a new artist who will take our art in a whole new direction and make our game much more appealing. We have plans to implement bosses, which will continue to add to the diversity of the gameplay, while making the game more challenging.

Team Members:
Eric Barr
Kyle Koh
Chris Ridmann
Jordan Feller
LaValle Thomas
Ryan Marzolph



HOW TO SOLDER

A STEP-BY-STEP GUIDE ON HOW TO SOLDER ELECTRONIC DEVICES

By Donald Ziems

What is soldering? It is the process of using a molten alloy of metals (typically lead and tin) to form a permanent mechanical and electrical bond between two metallic objects. Virtually every modern electronic device, and also any home with copper plumbing, has been soldered together.

Materials

To solder, you need very few things:

- A heat source
- Solder
- Solder sponge
- Diagonal cutters
- Something to solder

However, that list is extremely simplistic, as all categories contain a wide range of products, with some suitable for electronics work, and others that are definitely not intended to get near a circuit board. This next section will go over how to choose a heat source, solder, and a soldering sponge.

Heat Source

The heat source is perhaps the simplest item to find. Anything that can provide heat in excess of 800 degrees Fahrenheit can be used, but for most electronic work, a soldering iron is the tool of choice.

Soldering irons come in a wide range of styles, and a wide range of prices. A basic iron can cost as little as $5, while the high-end models can cost thousands of dollars. However, all irons are essentially the same thing, a handle, a heater, and a tip.

On the top-left is a basic soldering iron. As you can see, there is not much more to it than a handle, the heater, a tip, and a power cord. For most general purpose soldering work, this iron is sufficient, and is also the type of iron that most people start out with.

Top-Left:
Basic soldering iron

Top-Right:
Mid-range soldering station

Bottom-Left:
Solder

Bottom-Right:
Solder sponge

On the top-right is a mid-range soldering station. The iron itself looks similar to the basic iron, but there are two major differences. The first and most obvious difference is the base the iron plugs into. This model has a temperature control knob. Temperature control is very useful when you are working with parts of different sizes, smaller items, such as surface mount resistors, do not need a large amount of heat to solder into place, while large wires will typically need a high temperature to properly solder together. The second difference is this iron can have its tip changed. Over time, soldering iron tips oxidize from the high temperatures and the corrosive nature of molten solder, which will eventually require replacement. Many cheap soldering irons do not have replaceable tips, so replacing the tip requires replacing the entire iron. However, mid-range irons typically have interchangeable tips so that if it oxidizes, a new iron is not required. Soldering irons also come in a variety of shapes, but this is a topic for a more advanced tutorial.

One of the biggest differences in the costs of soldering irons is the ability to heat rapidly. Aside from the obvious time-saving that will result from a faster warm-up, the ability to rapidly generate heat is very useful for a soldering iron. A good way of thinking about a soldering iron is like a heat reservoir, where the heater keeps refilling the reservoir, and the part being soldered empties the reservoir. If the reservoir fills faster than it is emptied, then you do not need to wait in between each solder joint for the iron to get back up to temperature. Also, while it may seem counter-intuitive, the more heat applied to a part at once, the less heat is needed overall, and therefore the chance of overheating is reduced. This is because the lead of the component being soldered and the PCB will heat faster than the heat can be conducted away to regions that don't need solder, and so you can apply the solder sooner.

One important exception to this rule is the soldering irons on the market that claim instant heating and cool-down. While these claims are correct, these irons typically have a very small heat reservoir, and thus take a longer than normal time to heat the solder. Some models also function by passing an electric current through the solder, which is not desirable for highly sensitive components. This is why I do not recommend these irons for most soldering tasks.

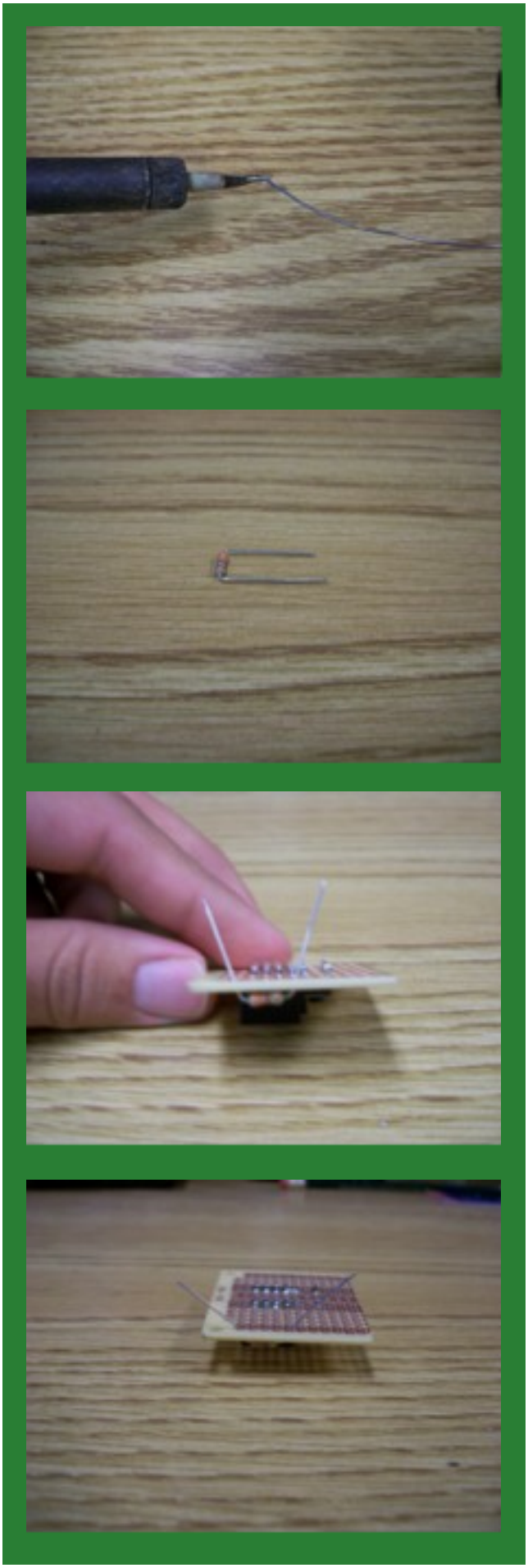
Solder

Solder is another item that comes in a variety of forms. The various brands can vary in their chemical composition, diameter, and the type of flux they use. The type of solder most commonly used for electronic work is 60% tin and 40% lead with a rosin flux core, more commonly referred to as 60/40 or Sn60Pb40 rosin core. This type is chosen because this alloy has a low melting point, and the rosin flux typically does not require any cleaning, except in highly specialized circumstances. It also has a natural method of informing people if the solder was applied correctly, it is shiny if well-applied, and has a very dull appearance if done improperly.

Other solder types exist, and one that is starting to become common is a mixture of tin, silver, and copper. This is becoming preferred in many industrial applications because it does not contain lead, a highly toxic metal. However, for general hobby electronics, this alloy is not typically recommended, because it has a much higher melting point, which can lead to damaging the item being soldered by overheating.

Solder Sponge

Over time, a black residue tends to build up on the tip of the soldering iron. This residue hinders your ability to apply solder effectively, and so must be cleaned off periodically. This is where the solder sponge comes in. Typically, it is a yellow sponge moistened with water that can withstand the high temperatures involved. Another type of "sponge" looks like a pile of brass shavings. However, they both work in the same way, you rub the soldering iron on them, and they clean the tip.



Applying the Solder

Now that you have your soldering iron and solder, its time to actually start putting things together. In this tutorial, I will be showing you how to solder a resistor to a standard protoboard, though the concepts apply to just about every through-hole part. (Through-hole parts are components where the leads go through holes in the PCB and are soldered on the backside, while surface-mount components are soldered directly to the surface of the PCB, and are typically much harder to work with.)

Step 1: Gather Materials
This step should be fairly self-explanatory, but before you can start, you have to get everything together.

Step 2: Plug the Iron In...and Wait
Now comes the time consuming part. You need to plug the soldering iron in, turn it on, and wait for it to heat up. If you have a basic soldering iron, this can take about a minute to a minute and a half. If you have a temperature controlled iron, set the temperature to about 310 degrees Celsius, or about 600 degrees Fahrenheit (about 1/3 of maximum power for irons without a temperature display). Allowing the iron to heat before use will save you the headache of creating cold solder joints.

Step 3: Tin the Tip
This is an important step that often gets overlooked, but it plays a major role in extending the life of your soldering iron. Tinning the tip is simply applying a small amount of solder to the tip of the soldering iron once it has heated up. This serves the dual purpose of cleaning the oxide layer that formed since the iron was last used, as well as protecting the tip from the air, and thus further oxidation, now that it is up to temperature.

Step 4: Prepare the Item to be Soldered
Now that the tip is tinned, you can set the iron aside briefly to prepare the board for soldering. In this case, we will bend the leads of the resistor so that they run parallel with each other, and then insert the resistor into the holes of the protoboard. Once inserted, slightly bend the leads again so that when you flip the protoboard over, the resistor does not fall out. This will make life much easier while you are soldering

Step 5: Add Heat
Now that the solder is in place, it is time to heat the item and add the solder. Take your soldering iron, and as seen in the picture, touch the iron to both the lead of the part, as well as the pad around the part you want to solder to. This begins heating everything up so the solder sticks. If you skip this step and try to go straight to adding solder, there is a good chance the solder will not properly adhere to either the pad or the part, and the joint will not make a strong connection. This should take approximately 1-2 seconds.

Step 6: Solder
Now that everything is heated, touch the solder to the pad or the lead of the item you are soldering. This will melt the solder, and it will flow around the pad and adhere to everything. Once the solder has attached, remove the iron and inspect your work. The resulting solder joint should have the appearance of a cone, with its base on the PCB, and the tip at the lead. If the joint looks like a ball of solder attached to the lead, then it probably did not adhere to the PCB, and you will need to try again. If the solder appears to be a blob, but connected to everything, you used too much solder. Using too much solder is not a bad thing, but it is wasteful, so try not to.

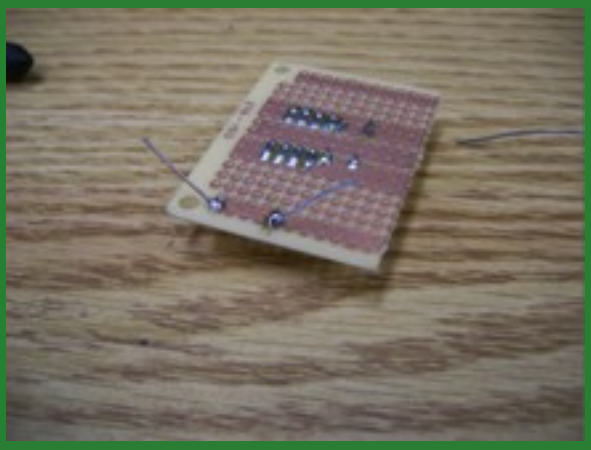
Above are two examples of poor soldering joints. On the left, we have an attempt that used far too much solder, but the solder did not adhere to the component's lead at all. This is a sign that the pad was heated, but the pin was not. On the right, we have an example of not enough solder being used. A mechanical and electrical connection was made, but it is not very sturdy. This is a sign that everything was properly heated, but there needs to be more solder applied.

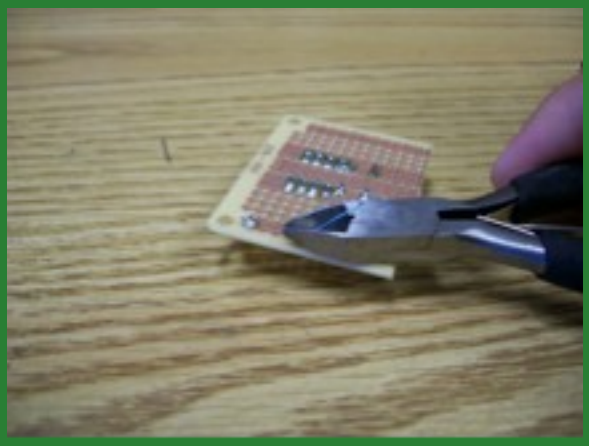
Step 7: Cooldown
This step can be skipped when working with resistors and other heat-tolerant devices, but when working with semiconductors such as diodes, transistors, and most microchips, this step will protect the devices from damage. After every joint, let the entire board sit for 15 to 20 seconds so that the item you are soldering into place can cool down. Most semiconductors cannot tolerate the heat of soldering for more than a few seconds, so if you try soldering a 40-pin microchip (for example) in one pass, it will likely have overheated by the time you reached pin 5.

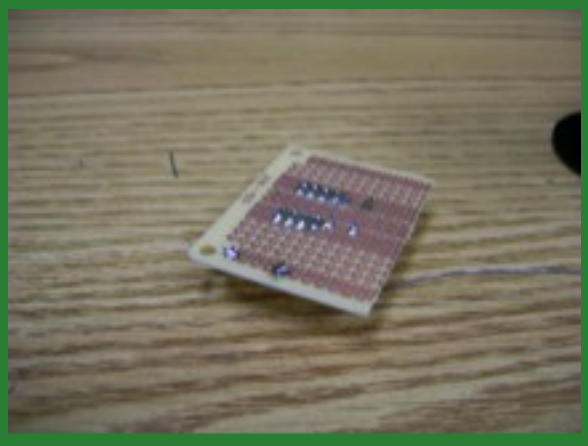
Step 8: Trim
For most resistors and capacitors, the components come with leads that are far longer than what is needed, and so to save your work from becoming a cluttered mess, trimming the leads is recommended.

Step 9: Repeat until Done
Since very few projects have only a single part, now you need to repeat steps 4 through 8 until you are done.

Conclusion
That is all there is to it! Soldering is a fairly simple process that most people can do, and can be useful in a wide range of fields. From assembling a robot to clean your room while you are away, to repairing that pair of headphone your little cousin accidentally cut, soldering is an important skill to have.







Say Goodbye To Your

By Erik Johnson

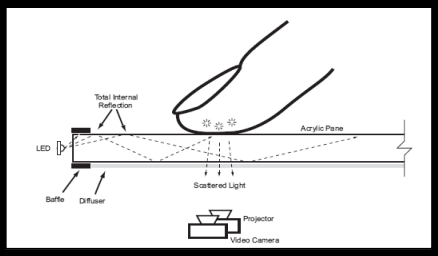
In the 2002 film *Minority Report*, there is a scene where Tom Cruise's character approaches a futuristic computer terminal to search through some data. That probably doesn't sound very exciting to you, but the moment is one of the coolest in the movie. As Cruise moves to the computer, a holographic screen pops up in front of him and he reaches out and starts interacting with the machine. Videos, audio, pictures, and text all appears on the screen and Cruise's character simply uses his hands and fingers to grab and rearrange the information, navigating through them effortlessly. Using human hands to seamlessly control the machine looks so cool, futuristic, natural, and intuitive. But this interface only existed science fiction, so in the real world we rely on clumsy mice, keyboards, and single-touch screens. It didn't seem like we would see *Minority Report* become reality any time soon.

The 2006 TED conference, however, changed all that. New York University researcher Jeffery Han demonstrated a multi-touch computer interface that was eerily similar to *Minority Report*. The large display could support any number of users or finger touches for a whole new interactive experience. Since the memorable demonstration, many developers have begun to explore multi-touch interaction systems. Notably, Microsoft has produced the Surface, a large table-sized multi-touch computer system, and Apple has produced the iPhone featuring simple two finger multi-touch interaction. Multi-touch systems open the doors for large table or wall sized installations, such as the Surface, that allow many users to interact simultaneously with the same data and applications. For example, Chicago's Ohare Airport recently unveiled an Accenture Touch Wall, allowing airline passengers to look up flight arrival times, weather, and more using the multi-touch wall. At the same time, multi-touch technology allows for gesture recognition on small devices, such as the iPhone, which greatly reduces the hassle of interacting with tiny screens.

In Fall Semester 2007, the University of Illinois at Urbana-Champaign IEEE student chapter also started a project to explore multi-touch interaction technology through the SEED program. The goal of the project was to build a multi-touch computer screen using the Frustrated Total Internal Reflection (FTIR) technique (see Sidebar). By using FTIR, IEEE could construct a 24 inch by 18 inch screen cheaply and easily. The original screen was built by over a dozen IEEE student members for under $150 in materials. IEEE students also coded image processing software and demonstration applications from scratch using Intel's OpenCV, an open-source computer vision library. Using a simple Finger-Painting application, The student members demonstrated the system successfully at the 2008 Engineering Open House.

Background

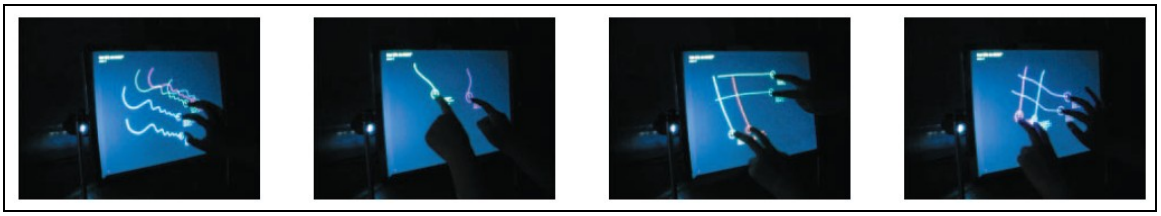
New York University Research Jeffery Han was the first to propose the Frustated Total Internal Reflection (FTIR) technique for multi-touch computer interaction. The technique uses infrared light from LEDs placed against a clear, acrylic pane. The pane serves as a waveguide for the infrared light which is "trapped" in the pane by the phenomenon of total internal reflection. When the infrared light hits the top or bottom of the pane, the angle is so shallow that rather than traveling out of the pane, the light is reflected back into the acrylic. The reflected angle is determined by the refraction index of the two materials. When the materials are acrylic and air, the reflected angle is shallow and the light continues to travel in the acrylic pane, becoming "trapped." When the materials are human fingers and acrylic, the reflected angle is very steep and the light leaves the acrylic pane. The scattered light provides a way to sense the presence of fingers. Using an infrared



camera pointed at the screen, the system creates an image that is mostly black with bright spots where fingers are pressed against the acrylic. The infrared camera is attached to a computer, which is able to locate the bright spots. Since the computer simply searches the image for bright spots, there is no inherent limit to the number of users or individual touches supported by the system. The computer also runs the image processing software and applications. The visual output of the application is projected onto a screen or diffuser behind or in front of the acrylic screen. The FTIR method is attractive because it requires only an acrylic pane, infrared LEDS, a small projection screen, and a USB or firewire infrared camera and can interface with any computer and projector.

Building on the success of the Engineering Open House experience, IEEE members continued to improve the project for the 2009 Engineering Open House. The Electrical and Computer Engineering department's machine shop constructed a new, adjustable frame. The student team purchased a new camera and infrared filter, resulting in better and more robust detection of touches. IEEE members rewrote the original image processing software and one team member managed to create a multi-touch version of the arcade game Missile Command in a one-night programming binge. Thanks to the students' hard work, the project was a major success at the 2009 Engineering Open House, winning the 1st place prize for returning technical project.

The prospects are exciting for the IEEE multi-touch computer screen and multi-touch technologies in general. The IEEE screen has become a platform for new projects in image processing and multi-touch software development. This summer, a human-computer interaction project is being carried out by the Social Spaces research group in the Computer Science department. Starting in Fall 2009, the IEEE multi-touch screen project will be back for students interested in developing software or exploring new human-computer interaction hardware projects. Interested students should e-mail Erik Johnson (ejohns24@illinois.edu) about potential projects.



Simple multi-touch gestures demonstrated by Jeffery Han

Multi-touch technologies are currently revolutionizing the way we interact with computers. Multi-touch interaction is quickly moving past the "gimmick" stage and becoming an integral part of the computing experience. IEEE's Multi-touch screen project has and will continue to provide a chance for IEEE student members to explore and experiment with this emerging technology.

ALBERT EINSTEIN'S RIDDLE

ARE YOU IN THE TOP 2% OF INTELLIGENT PEOPLE IN THE WORLD? SOLVE THE RIDDLE AND FIND OUT.

There are no tricks, just pure logic, so good luck and don't give up.

1. In a street there are five houses, painted five different colours.

2. In each house lives a person of different nationality

3. These five homeowners each drink a different kind of beverage, smoke different brand of cigar and keep a different pet.

THE QUESTION: WHO OWNS THE FISH?

HINTS

1. The Brit lives in a red house.

2. The Swede keeps dogs as pets.

3. The Dane drinks tea.

4. The Green house is next to, and on the left of the White house.

5. The owner of the Green house drinks coffee.

6. The person who smokes Pall Mall rears birds.

7. The owner of the Yellow house smokes Dunhill.

8. The man living in the centre house drinks milk. 9. The Norwegian lives in the first house.

10. The man who smokes Blends lives next to the one who keeps cats.

11. The man who keeps horses lives next to the man who smokes Dunhill.

12. The man who smokes Blue Master drinks beer.

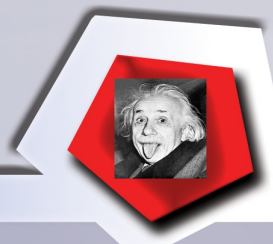
13. The German smokes Prince.

14. The Norwegian lives next to the blue house.

15. The man who smokes Blends has a neighbour who drinks water.

ALBERT EINSTEIN WROTE THIS RIDDLE EARLY DURING THE 19th CENTURY. HE SAID THAT 98% OF THE WORLD POPULATION WOULD NOT BE ABLE TO SOLVE IT.

+



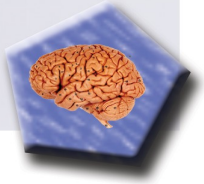
				4	8	3		
			2			6		1
7							2	
			5	2		8		
5		9		3		4		7
		8		7	6			
	5							8
1		4			9			
		2	7	1				

Fill in the grid so that each row, each column, and each 3x3 box contains the numbers 1 to 9, once and once only.

Sudoku

Ponturu

Connect the islands with bridges so that the number of bridges equals the number on the islands. all the islands must connect with one another, and the bridges can only travel vertically or without crossing. there can be none, one or two bridges between each pair of islands.



LOADING...
N 40° 06.598 W 088° 13.704

FACTS: The Alma Mater

Its coordinates are N 40° 06.598 W 088° 13.704.

Long ago, 90 years to be specific, the Alma Mater statue was cast by the American Art Bronze Foundry and Jules Berchem and Sons, Chicago.

Labor and Learning, the two men behind the Alma Mater, represent the university's motto.

In 1929, the Alma Mater was officially unveiled on Alumni Day (June 11).

Not many people know that the statue was originally placed behind Foellinger Auditorium. At night, spotlights were used to cast the shadows of Labor and Learning onto the rear wall of the building, making them appear larger than life.

On August 22, 1962, the Alma Mater was moved to its present location in front of Altgeld Hall.

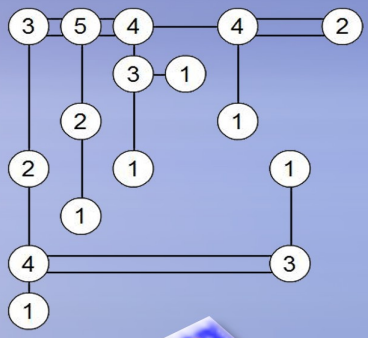
In the vicinity of Labor's feet is a map book. Rumor has it that on its pages, an early map of campus can be seen. However, in reality the markings are generic engineering symbols.

Sayings of the Alma Mater: Two quotes, "To thy happy children of the future, those of the past send greetings," and "Her children arise and call her Blessed — Proverbs 31:28" are inscribed into the granite base.

Solutions

house	1	2	3	4	5
color	yellow	blue	red	green	white
nationality	norweigian	dane	brit	german	swede
drink	water	tea	milk	coffee	beer
smoke	dunhill	blend	pall mall	prince	bluemaster
pet	cats	horse	birds	fish	dogs

2	1	5	6	**4**	**8**	**3**	7	9
4	9	3	**2**	5	7	**6**	8	**1**
7	8	6	1	9	3	5	**2**	4
6	7	1	**5**	**2**	4	**8**	9	3
5	2	**9**	8	**3**	1	**4**	6	**7**
3	4	**8**	9	**7**	**6**	2	1	5
9	**5**	7	4	6	2	1	3	**8**
1	6	**4**	3	8	**9**	7	5	2
8	3	**2**	**7**	**1**	5	9	4	6



Sources:

The Einstein puzzle:http://www.naute.com/puzzles/puzzle13.phtml
Sudoku: www.websudoku.com
Ponturu: http://www.welovepuzzles.com/channel/japanese/ponturu/

Infinera

Infinera is a technology innovator dedicated to transforming the optical networks at the core of the internet. Infinera's products, utilizing our breakthrough Photonic Integration Circuits, have quickly made us the #1 supplier of long haul optical networks in North America, and #4 worldwide. Our products are raising standards on a technical level, and lowering barriers from an economic perspective. As the world's consumption of bandwidth increases, Infinera provides the scalability to keep up with this demand.

Infinera will be visiting the University of Illinois, Urbana-Champaign in the coming semester. Please keep an eye out for future correspondence to attend a technical presentation by the Director of Manufacturing.

We hope you are able to come meet with us to learn more about Infinera and future Internship opportunities!