Spring 2005

CSE Pipeline

MICHIGAN STATE UNIVERSITY

Department of Computer Science and Engineering/College of Engineering

Alumni Lead Tsunami Relief Project

As hundreds of volunteers worked around the clock to help put the tsunami-hit regions of Asia back on track, halfway across the world, two Michigan State University computer science alumni were doing the same.

Sharathchandra Pankanti (PhD '95) and Salil Prabhakar (PhD '01) came together in an effort that would eventually round up equipment donations worth more than $1.5 million from a multitude of corporations, and hundreds of man-hours of volunteer work to help expedite relief work in the affected areas.

The earthquake that triggered the killer waves in Dec. 2004 in the Indian Ocean clocked 8.9 on the Richter scale and claimed about 300,000 lives across 12 Asian countries and in Africa. It was second only to a nine-pointer in Alaska in 1964. Considering the size of the calamity, it seemed only a matter of time before technology would be harnessed to aid the largest rescue operation in history.

Minnesota-based Laser Data Command, Inc. (LDC), which makes software to track airline passengers, modified 1,000 units of its product to capture fingerprints, face images, and other personal information. This would facilitate speedy identification and disposal of bodies and minimize the outbreak of disease.

The problem was to round up hardware that would be compatible with the software, and assemble the different components in time for them to be shipped thousands of miles away to Bangkok, Thailand.

Volunteers work all night putting together the system components to be shipped to Bangkok, Thailand.

LDC approached IBM's Crisis Response Team (CRT) for help and Pankanti, based out of IBM's T.J. Watson Research Center in New York, was entrusted with the task of setting up the supply chain. The CRT had already worked in the region and 1,000 IBM Thinkpads, loaded with the appropriate software and components, would be a critical resource for the logistical and management systems required.

Pankanti was looking at a logistical nightmare of sourcing laptops, cameras, and fingerprint readers from different locations in the United States within a severely crunched timeline.

He enlisted the help of Prabhakar, his former MSU colleague and chief scientist at California-based DigitalPersona, Inc., to carry out the job. Phone calls were made, e-mails hastily dispatched, and old contacts leaned on to build collective corporate might behind the effort.

Prabhakar brought in 1,000 fingerprint sensors made by DigitalPersona. He was also successful in sourcing an equal number of webcams from California-based Logitech and wrote fresh programs to make the sensors compatible with the software.

IBM donated the laptops while Northwest Airlines was the carrier, flying the equipment across the country to a single assembly hub in Minnesota, and onward to Thailand.

As the equipment poured in, IBM employees worked all-night assembly lines (with assembly rigs donated by VectorMAX Corp.), testing the product and packing units for shipment. The team spent long hours through the New Year's weekend cutting through technical and legal glitches in order to send the shipment on its way.

The effort reflected the underlying human spirit to defy adversity, Pankanti says. "The combined human effort far exceeded the item value. This could not have been accomplished for any amount of money."

His comment echoes the combined sentiment of thousands of selfless volunteers who have put in backbreaking hours to bring a semblance of normalcy back into the lives of the people of Asia.

The equipment donation from all sources totaled $1.5 million with IBM heading the list of benefactors, donating $1.3 million in laptops, which was just a part of the $3 million in total contribution from IBM. Pankanti says the software that was originally intended to identify casualties is also being used to bring together displaced family members and to create travel documents for survivors.

The system has also been put to use in other affected countries such as Sri Lanka, and donations were made to Indonesia and India, but it was unclear whether these governments had accepted the offer. ▲

(Pankanti and Prabhakar received their PhD degrees under the supervision of Anil Jain, University Distinguished Professor of computer science and engineering.)

— Arjun Kashyap

Laura Dillon

Message From the Chairperson

What was once purported to be an old Chinese curse—"May you live in interesting times,"—has since come to convey a sense of wonder and excitement during times of rapid change and discovery. Far from a curse, these current times are times of immense opportunity for those of us involved in computing and information.

It is this sense of excitement that our faculty impart to aspiring computer scientists starting with their very first programming course and continuing through each student's individual path of discovery. In fact, for all of us—from beginning freshmen, to advanced graduate students, to faculty and staff—these are indeed interesting times.

So, what accounts for all the excitement at MSU? The confluence of several factors.

Computing and information are revolutionizing every aspect of our world at unprecedented and previously unimaginable rates. Futurists predict that rates of change — of discovery, innovation, and invention — in the 21st century will be many times faster than in the 20th century. Hence, even conservative estimates suggest that the first decade of the current century will produce more changes than occurred in the past 100 years.

The date Feb. 12, 2005, is an important one in the history of Michigan State University. Not only was it the beginning of the university's 150th year, but it was also the official beginning of the administration of our new president, Lou Anna K. Simon.

Our sesquicentennial year will be filled with activities that celebrate our rich heritage and engage us in strategic visioning for our future. Computing and information have already demonstrated a tremendous capacity to advance knowledge and transform lives—so much so that we know they will play strategic roles throughout the mission of the 21st century land-grant university.

To this end, the CSE faculty are collaborating with their counterparts from other colleges on campus to organize events that will bring people together around the theme of computing and information. The 3rd Annual MSU Cybersecurity Workshop held last November highlighted synergistic research opportunities in health information technology between the university, the state of Michigan, and the healthcare industry.

On Feb. 17, 2005, William Wulf, president of the National Academy of Engineering, delivered a University Distinguished Lecture titled "Opportunities and Challenges for Universities from Information Technology." Two days later, about 80 faculty and staff participated in an all-day workshop called "Strategic Visioning for Cyber-infrastructure, Computing, and Information."

So, the excitement continues to build as "Team MSU" engages in conversations via broad-based focus groups and campuswide forums to envision strategic plans for the university's next 150 years.

In this issue of *CSE Pipeline*, you will find information about specific people and events that are making for interesting times at CSE. What you will find here is just the tip of the iceberg, and we invite you to look for details on our Web site. Better yet, come visit us in person. And bring your family and friends.▲

MSU Women in Computing

January saw the creation of a new student group in CSE that will bring together women interested in computing technology. The group was initiated by five students who came together to network, share, and learn from their collective knowledge and interests in the field.

Called "MSU Women in Computing," the group's first activity was a book reading of *Unlocking the Clubhouse: Women in Computing* by Jane Margolis and Allan Fisher. The book examines the low representation of women in the technology world.

Laura Dillon, the chairperson, Teresa Vandersloot, undergraduate student advisor, and Laura Campbell, visiting faculty, will advise and assist the group.▲

Left to right: Tisha Melia, Randee Bierlein, Teresa Isela Vandersloot, Niharika Joglekar, Kirsten Partyka, Lauren Revard, Laura Campbell, Laura Dillon, Jennifer Mott, and Kira Johns at the book reading.

DaimlerChrysler Adopts Student-Designed Tracking System

Art Covert, a member of the MSU team that built the tracking system for DCX, says the project taught the team to solve complex real-world business problems.

DaimlerChrysler Corp. (DCX) expects to save $360,000 annually on its truck fleet in 2006, thanks to a new tracking system developed by MSU CSE students.

Computer science students Kun-Li Chen (BS '04), Art Covert (BS '04), and Scott Creighton (BS CSE and Honors College '04) from the collaborative design class got together with a technical team from DCX to build a prototype of the new system that would be installed on the trucks.

The project was part of the Senior Capstone Course (CSE 498) that brings all the concepts learned in previous CSE courses together in a practical application. Student teams work with clients from industry and nonprofit organizations, and from within MSU, to develop software and hardware solutions.

"My team and I had to come up with our own architecture and specifications for a system to connect a fleet of semi-trucks in real time," Covert says.

After considerable research, the students decided to use a Global System for Mobiles (GSM) connection for the system through a cellular data provider. The system's purpose is to indicate to dispatchers the exact location of a truck and to monitor shipments. It is a significantly cheaper alternative to the existing onboard computers that use satellite communication.

The MSU-DCX team replaced the existing system with a cellular network, significantly reducing operating and maintenance costs. Another reason the team chose a cellular network was its wider coverage area and accessibility to the Internet.

With a Global Positioning System (GPS) feature called geofencing, the new system is also capable of triggering alerts when a truck arrives or leaves a plant, or when it crosses a state or national border.

DCX uses its 400-strong truck fleet to cart parts and sub assemblies from internal and external manufacturing plants to assembly lines. The trucks ply out of three terminals in Toledo, Ohio; Detroit, Michigan; and Windsor, Ontario.

The students planned the system architecture, chose technologies for data interchange, and designed a proof of concept.

The engine control module captures vehicle performance data, such as mileage and fuel consumption, and tracks driver performance by recording speeds and sudden decelerations.

This is expected to result in long-term benefits such as reduced fuel costs as poor driving habits are corrected. It should also be possible to save the time currently spent on troubleshooting and repairs of onboard computers. The onboard computers are now equipped with a wide screen that is rugged and better suited for a rough ride.

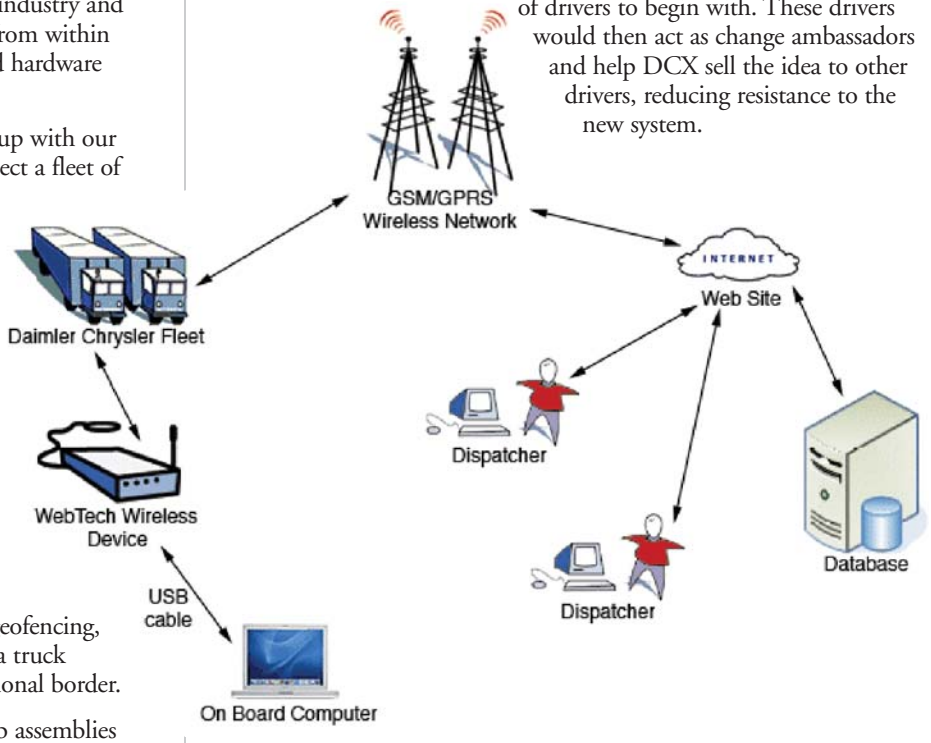
Other features include hands-free voice communication and the capability to upgrade and configure systems from remote locations.

For the pilot phase, DCX plans to install the system on two trucks from each terminal, starting in the fourth quarter of 2005. Additional features that support driver logs and fuel tax credits will be added in the second phase.

The log, required by the Department of Transportation, is a weekly record of mileage and hours accumulated by a driver. Fuel tax credits are accumulated when fuel is purchased in one state and consumed in another with a lower tax.

Both applications will require GPS data. After the completion of Phase II, drivers will be trained on the new system at all the truck terminals and the new process will be rolled out.

The system will go through a pilot program involving a small group of drivers to begin with. These drivers would then act as change ambassadors and help DCX sell the idea to other drivers, reducing resistance to the new system.



As most drivers already use cell phones, the company expects that drivers will be comfortable using the new technology.

Students who worked on the project say they valued the learning experience and broad scope of the work.

"We were charged with creating an entirely new system and proving that it would work. This goal gave us a much better feel for design, and for actually creating the specifications that other teams would use in the implementation," Covert says.▲

— Arjun Kashyap

Looking into the Future with a 3-D Face Verification System

We would all like to travel more easily on airplanes and conduct more secure transactions at the ATM machine. To do that, it would be useful to have a system that could sense our face and match it to a model stored on our credit card, thus verifying our identity and expediting and securing the transaction.

Dirk Colbry, Xiaoguang Lu, Anil Jain, and George Stockman from the CSE Pattern Recognition and Image Processing Lab (PRIP) and colleagues at Pixel Velocity Inc. of Ann Arbor, Michigan, are developing such a biometric verification system, with a prototype machine to be completed by summer 2005. The project is funded by the Michigan Economic Development Corporation (MEDC).

Researchers in the PRIP Lab have been working on face analysis and verification for several years. Using a 3-D scanner, the system obtains, for each point on the face, the 3-D coordinates (x, y, z) of the point and the (R, G, B) color values (fig. 1).

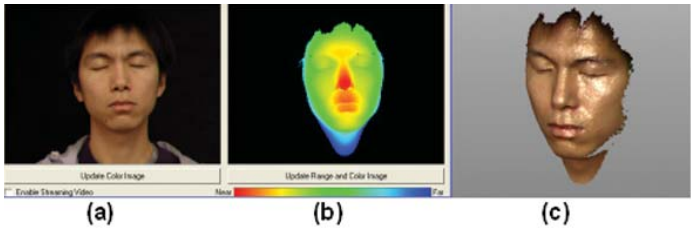


Fig. 1. An example of face scanning: (a) the RGB image; (b) the surface, or range image, closer points in red, distant points in blue; (c) 3-D rendering of the digital 3-D surface

The team has been successful in matching faces in various poses relative to the scanner; however, the commercial prototype system will work with a person facing the scanner, since such frontal scans enable feature detectors to find the eyes, nose, mouth, and chin in known relative locations.

Detecting and Matching Face Feature Points

We know the general shape of the prominent facial features and have designed specialized algorithms to find them (fig. 2). A matching algorithm called the Iterative Closest Point adjusts the pose of the model surface until it most closely aligns with the scanned surface. Only if the two surfaces align well is the match accepted. Intuitively, the model face can be thought of as a thin Halloween mask, custom-made to have the same shape and color as your face. This mask is then stored digitally on your credit card or smart card.

Fig. 2. Feature extraction examples. The plus symbols are manually identified points and the circles are the automatically detected points.

When you want to prove your identity at the airport check-in or ATM, the 3-D scanner will scan your face and make another mask in the same digital format. Imagine the matching algorithm sliding one mask over the other to find the pose at which they most closely match. (fig. 3). From this initial alignment, the two surfaces slide over one another until a large number of surface points align well. Only if the two surface masks align well enough is the identity of the person verified. If the surface points are within one millimeter from one mask to the other, and the colors match approximately, the matching algorithm confirms your identity. This gets you your money, ticket, or access to the gate.

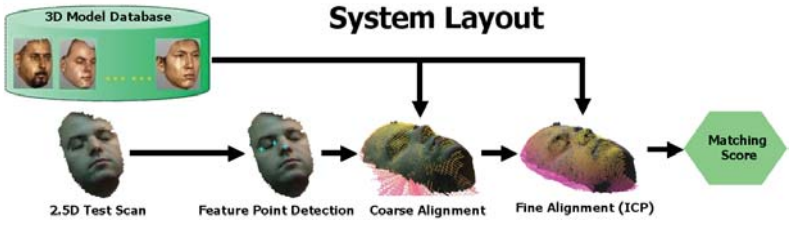


Fig. 3. Sketches of the face matching process

Our current commercial prototype compares only one face model—the one stored under an individual person's identifier. The nose tip, eye corners, and mouth corners are located on the sensed face surface. The model mask and scan mask are then aligned using three of these points. Figure 3 shows that a face scan could be compared to any number of face models stored in a system. This could be of value in monitoring some kind of "watch list." Comparing a scan to N face models could take N times as long as the 1-second match time we now have. But we could certainly do 100 matches to a list of suspected "bad guys" and be done in 2 minutes while someone waited to board a plane.

Results of Testing

Experiments performed through summer 2004 recorded an overall success rate of about 85 percent, although profiles and semi-profiles were being matched as well as frontals. The success rate rose to 98 percent when only frontal scans were considered. The goal for the commercial prototype is 99.9 percent for frontal scans, and current work shows the team is approaching that mark.

Some Problems

Face scans often contain significant noise that confounds simple analysis. Sometimes, surface data is unavailable in the eyes or in facial hair since the laser return is lost. In worse cases, incorrect surface data is recorded when surface patches near the eyes or nose tip are greatly exaggerated.

(continued on next page)

A final problem to note is the difficulty of the sensing environment in which a verification machine must operate, such as people with stubble on their faces or wearing jewelry. The matching algorithm will know if there is a problem, but will it know enough to advise the person how to make the adjustments needed for a successful verification?

The Future

Perhaps in the near future you will be asked to report to your bank so you can record your face model on your bank card. Thereafter, a 3-D scanner may scan your face while you are using an ATM machine so it can compare it to the model on the card you inserted into the ATM.

Or you might enroll at the airport to become a registered frequent flyer. And maybe a Sony Play Station or X-Box will be able to read your card so it can put your face on your avatar in a kick-boxing fight!▲

—George Stockman, professor of computer science and engineering

Faculty and Staff News

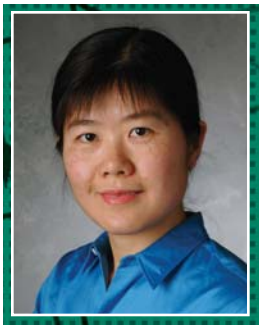
Anil Jain, University Distinguished Professor, was appointed associate editor of a new journal - *IEEE Transactions on Information Forensics and Security.* The quarterly journal will publish archival research on information forensics, information security, surveillance, and systems applications that incorporate these features. The IEEE Signal Processing Society is sponsoring the journal; the first issue is scheduled for April 2006.

Wayne Dyksen, professor and associate director of MATRIX — The Center for Humane Arts, Letters, and Social Sciences Online, coordinated the "University Distinguished Lecture Series" on Strategic Visioning for Cyberinfrastructure, Computing, and Information, in February 2005. The event focused on drawing up a common, holistic vision for computing and information at MSU.

Charles Ofria's research has produced Avida – a software platform that simulates evolution via digital organisms and is helping a team of MSU scientists, biologists, and philosophers to test Darwin's theories. Avida was the cover story for the February 2005 issue of *Discover* magazine and has received widespread attention in the media. The software uses strings of commands that mutate like DNA in an attempt to unravel the mysteries surrounding evolution.

Congratulations to **Kurt Stirewalt** on his promotion to associate professor with tenure. He has a PhD ('97) from the Georgia Tech College of Computing. Prior to joining MSU, he worked as a research scientist at Georgia Tech Graphics Visualization and Usability (GVU) Center and as a member of the technical staff at MITRE Corporation in McLean, Virginia.

Richard Enbody



Li Xiao

Richard Enbody, Kurt Stirewalt, and **Li Xiao** received an award from Microsoft Research for a project entitled "Trustworthy Computing: Integrating Threat Modeling and Privacy into an Undergraduate Computer Science Curriculum." The project is an effort at building trustworthy software systems necessitated by the increased use of technology. The project will integrate cybersecurity into the undergraduate curriculum with a focus on integrating security into the software design cycle. Enbody and other faculty members, along with computer science senior Thomas Wolf, met with Microsoft officials at the company's headquarters in Redmond, Washington, to discuss the initiative.▲

Visiting Scholar Returns to MSU after 24 Years

In 2002, Zhisheng You received China's National Labor Day Medal, the highest-level government award.

Professor Zhisheng You often tells people that he "owes his success" to his stay at Michigan State University. He is founder, vice chairman, and general manager of Sichuan University WiseSoft Co., Ltd., in Chengdu, China.

He first came to MSU in 1981 as a visiting scholar in the Department of Computer Science and Engineering. In the early 1980s, You explains, Sichuan University was MSU's "brother university." More than 50 scholars and students of Sichuan University came to MSU, sponsored by the Chinese government as well as Sichuan University, the largest university in southwest China.

"My colleague Mr. He and I came to visit the Pattern Recognition and Image Processing Laboratory in the Computer Science Department, which was very well known in China and around the world," says You.

While at MSU, he worked closely with Anil Jain, University Distinguished Professor in the Department of Computer Science and Engineering.

"Going from undeveloped China to an advanced world, everything was new and impressive," says You. "Although I missed my family and my home country, I soon began to understand and admire the sophisticated education system of MSU and benefit from the free and challenging research and learning environment."

You says he was impressed with Jain's "profound understanding of pattern recognition and image processing, and his ideas and disciplined methodology in guiding his students." But what especially impressed him was Jain's commitment to scientific research. "His spirit of focus, energy, and consistency has influenced my entire life."

After returning to China in 1983, You established the Institute of Image and Graphics of Sichuan University, and has served as professor and director. Initially, most of the institute's research was funded by the China National Science Foundation. "We gradually focused our research and development work on application software and systems and began to provide image-analyzing software for hospitals and iron plants," You says. The income generated by that market supported the next phase of research and development.

In 1992, the Institute of Image and Graphics completed China's first air traffic control (ATC) radar simulator for the ATC bureau and colleges. Now, all of the ATC centers in the country are using the simulators to train their controllers. "These products have been more successful than we expected."

In 2000, Sichuan University decided to spin off a company from the institute—WiseSoft Co. Now, Sichuan University is the number one investor in the company.

Today, more than 100 airports in China use WiseSoft's air traffic control automation system. But an even bigger market than air traffic control is the ground traffic market. "Ground traffic control technology is developing very fast, including visual surveillance, violation detection and enforcement, traffic light control, and electronic tolling systems," says You. "We joined this market in 1998."

License plate recognition (LPR) systems, which are currently in use at the U.S./Mexico and the U.S./Canada borders, aid in tracking stolen vehicles and prevent cars from being smuggled across borders. As a car approaches a border, the license plate is captured by a camera and a search against a database of stolen cars begins. By the time the vehicle reaches the immigration inspector, a license plate match may already be available.

"Professor You is now developing this type of technology in China, which they haven't had before," says Jain. "This is a first for them."

Many of these WiseSoft license plate systems have now been installed on roads in China to aid in identifying uninsured and stolen vehicles. The company has also developed a pattern recognition (PR) system for Beijing and Shanghai, which is in use on most of their main road intersections, making it easy to track average travel times. Beijing intends to utilize these technologies—integrating this PR system to give real-time accurate traffic information—during the 2008 Summer Olympics.

Since 1984, Jain has traveled to China six times to visit You, most recently in July 2004. "I've seen him make professional progress every time I visit. He's doing amazing work," says Jain.

"He started from a very humble beginning and modest research record," Jain says, "and he has accomplished a huge mission in bringing high-tech indigenous technology to China. That's a great accomplishment."

"That two years I spent at MSU was the turning point in my life," says You. "Without this experience, my life would be totally different."

You is looking forward to returning to campus for a visit this spring—this time with his wife. "I am eager to see Dr. Jain again," he says. Professor You will be presented with an honorary engineering alum award during the spring commencement ceremony on May 8.▲

— Laura Luptowski Seeley

The Iraq Experience: Graduate Student Returns with Fresh Perspective

Avi in the Green Zone — a heavily guarded area of cordoned-off streets in central Baghdad that houses command centers for the American military, various embassies, and the offices of consulting companies. The main palaces of former President Saddam Hussein fall within the zone.

In the scorching heat radiating from the Iraqi desert with the mercury rising above 120 degrees, Avi Ravindra (MS '05) felt closer to home than he actually was.

"Sometimes I can almost smell the cool breeze of my back yard and the sight of green grass all over the place. Suddenly, I realize I'm not there yet, but what makes me happy is knowing that I'm already at an 'oasis in the desert,'" the Saginaw native writes in his musings from Iraq.

The oasis Ravindra refers to is his platoon, with whom he experienced a great sense of kinship and grew to trust with his life, as he took on dangerous missions in a hostile land.

Ravindra spent a year in Iraq as a part of the 706th Transportation Company in Al Taji, 20 miles north of Baghdad. He is back now, with a newfound appreciation for the luxury of peace and freedom.

Inspired by a video he saw six years ago, Ravindra joined the army and was called to active duty last year. He landed in Iraq in February 2004, after training for two weeks in Kuwait, and was stationed at Camp Cooke.

"It was in the heart of the Sunni triangle and a former Iraqi chemical weapons base," he says.

As a soldier in the unit's 2nd platoon, Ravindra's duties involved setting up the local area network and Internet connections for the platoon. He was also called upon to escort civilian fuel trucks around the country.

"That is when I learned about their (Iraqis') culture and traditions. By my personal experience, Iraqis are very nice people. They have never experienced a single day of freedom as long as they can remember, and yet they adapted to our needs with minimal effort, and they were very nice to me," he says.

He also notes that there were times when local people blamed the troops for the escalating insurgency. However, Ravindra penetrates standard media images of bombed-out townships and gun-toting militia on the streets, to bring a refreshing perspective about Iraq as a country.

"It is a country to be seen when it's peaceful; there is a lot of history there, like the city of Babylon. And, of course, the huge man-made lake around Saddam's palace is a sight," he says.

The one common thread between his Iraq experience and MSU is that he learned to achieve goals, Ravindra says. This lesson may well have put his next goal — to graduate next December — clearly in his line of sight.▲

—Arjun Kashyap

Avi and his platoon

MICHIGAN STATE UNIVERSITY

Department of Computer Science and Engineering
Michigan State University
3115 Engineering Building
East Lansing, Michigan 48824

MICHIGAN STATE UNIVERSITY

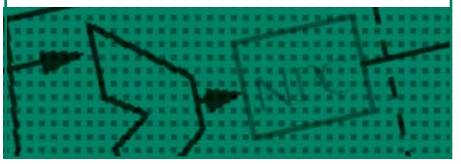
CSE Pipeline is published by the Department of Computer Science and Engineering.

3115 Engineering Building
Michigan State University
East Lansing, MI 48824

Chairperson: Laura Dillon
Phone: (517) 353-6484
E-mail: csechair@cse.msu.edu
Web: www.cse.msu.edu

Editor: Laura Dillon

Student writer: Arjun Kashyap



Student News

Kimberly Weaver — Outstanding Senior

Kimberly Weaver was recognized by The Society of Women Engineers and Ford Motor Company with the Outstanding Senior in Computer Science award at the Women in Engineering awards banquet on Feb. 3, 2005. The award was sponsored by Ford Motor Company and presented by Adam Haas, MSU alum and IT professional at Ford.

In addition to her sterling academic performance, Kimberly is an active Spartan. She was treasurer of the Spartan Handbell Choir and has participated in the MSU Science Fiction Genre Evolution Project. Kimberly enjoys cheering in the Izzone and playing intramural soccer and floor hockey.

She spent a summer studying in Austria and a semester at the Friedrich-Schiller-Universitat in Jena, Germany, where she sang in the university student choir. Kimberly is a member of Upsilon Pi Epsilon and serves as corresponding and recording secretary of Tau Beta Pi.

Congratulations to the following students who will be honored for academic excellence at the Academic Awards ceremony in April.
Sophomore: **Andrew Gorczyca**.
Juniors: **James Pita**, **Andrew Kreling**, and **Brian Gearhart**.
Seniors: **Adam Todd**, **Ali Abdollahi**, **Navid Motlagh**, and **Justin Hoffman**.