Short Faculty Presentations

- Priya Narasimhan
- Martin Griss
- Jim Morris
- Pei Zhang
- Dan Siewiorek - phone
- Joy Zhang
- Ray Bareiss
- Norman Sadeh - phone
- Tony Wasserman
- Khalid Al’Ali
Priya Narasimhan
• Visually impaired people need increased independence for a higher quality of life
  - Grocery shopping, cooking, transit, currency
• Brailling the world not a solution
  - ~80% of blind people are not Braille-literate
• New infrastructural investment not feasible
  - Stores cannot provide dedicated clerks or overhaul existing infrastructure
• Dedicated devices not practical
  - One more device for a blind person to carry
Our Solutions

• Software on an Internet-enabled, GPS-equipped smartphone
  - Existing device already owned by user
• Exploit barcodes on products
  - Existing, widespread
  - Inexpensive, personal barcode scanners available
• Use cellphone’s onboard camera, where needed
• Exploit online transit schedules
• Participatory design - blind developer on team from day one
What We’ve Developed

• Grocery shopper
  - Combination of a Bluetooth barcode-scanning pencil looking up an online product repository

• Currency identifier
  - Using the smartphone’s camera to scan currency and then use object recognition to identify the currency

• Commute planner
  - Provide notifications of how far away various forms of transit are, based on transit schedules and GPS information
Yinz Cam: Enhanced Fan Experience

- Fans cannot catch every angle of a hockey game
  - Game moves fairly fast
- Even fans up against the glass cannot catch every view (when action is furthest from them)
- Particularly important for nosebleed seats

Goal
- Improve the viewing and interactive experience of fans in the arena/stadium
Challenges

• Three big challenges: coverage, capacity, security
• 17,500 fans in current arena; 25,000 fans in new arena
  - Imagine every fan simultaneously accessing an action replay of a big fight, a goal or a save
• Streaming video wirelessly to so many mobile devices, in real-time, with minimal latency
• Problems
  - Where do we locate the access points?
  - What video feeds can we access? What unique feeds can we provide that broadcasters won’t/can’t show?
  - What devices can we support? How do we distribute authentication credentials to all of the subscribed fans?
  - How do we deal with the UI on variety of mobile devices (touch screens vs. non-touch screens)?
  - How can we maximize the real estate on phone displays?
  - How do we prevent forwarding of content outside the arena/stadium?
Martin Griss
“Personal Assistants”

Software agents, context, mobility, machine learning

• Mobile Professional – meetings, ...
• Email & SMS Assistant – prioritize, defer, ...
• Travel Assistant – inter-modal travel, ...
• SmartSpaces – entertainment, eldercare
• Usable Security and Privacy for Context-Aware Mobile Applications
• Privacy and Security in Real Time Monitoring Systems
Smart Spaces

Software Agents

TV

TiVo

RFID

Ultrasonic locator

Personal Interface

GPS/cell
Smart Spaces for Home-Bound Elders

- RFID Sensors, vision and UPC for food and medication management
- Remote monitoring by caregivers and family
- Local (micro-) analytics influence upstream systems
- Voice and touchscreen interfaces, context to simplify food ordering and management
- Interior positioning to support context-aware reminders
- Rule-based and machine learning software agents to provide proactive support and detect anomalous behavior, escalate to appropriate caregivers and family

Sponsor: SAP Research
Usable Security and Privacy for Context-Aware Mobile Applications

- Improve end-users’ ability to privately and securely interact with their environment and data while mobile
- Imperative to sense and understand a user’s context
- Mobile interactions need to be particularly unobtrusive and seamless
- Apply context-aware mobility to security and privacy
- Leverage context as additional sources of authentication and to control access to information and services

**Sponsor: CyLab  [Griss, Dey]**
Jim Morris
Jim Morris

How can the cell phone...

...reduce highway congestion?
...preserve the environment?
...build community?

www.cs.cmu.edu/~jhm/SafeRide.pdf
dynamicridesharing.org, a wiki
Ride Sharing!

- Reduce the use of single-occupancy vehicles.
- Provide central nervous system for regional surface transportation.
- Use GPS Smart Phones + ideas from 511.org, Google Transit, Zipcar, SmartBike, Facebook, eBay, and eHarmony.
- Many people have had this idea.
  - Ben Rosen, legendary VC
  - Scott Adams, *Dilbert* creator
  - Robin Chase, founder of ZipCar.com
  - Steve Raney, local consultant, Cities21.com
  - Dan Kirshner, founder of RideNow.org
  - Harvey Appelbe, founder of MapFlow.com
Example: SF to SV Commute

- Consider 1,000 commuters living in 10 neighborhoods and working at 20 companies.
- Assuming uniformity, about 100 live in each neighborhood and about 5 in each neighborhood work at the same company.
- If the probability of a compatible match between two neighbors who are co-workers is 0.1, the probability of a person finding a ride is 0.3.
Allow Car Switches on Highway 101

- 1,000 Commuters
- 100 live in each of 10 neighborhoods.
- 50 work at each of 20 companies.
- 100 residents of X drive on 101.
- 50 workers at Y drive on 101.
- If the probability of a compatible match is again 0.1, the probability of someone getting a ride to work is 0.8.
- If there are 300 in each neighborhood and 300 in each company, the odds improve to nearly 1.
- Generally, highway, bridge, or public transit stop can be a virtual hub.
Allow Pick-ups and Drop-offs Anywhere on Driver’s Route

- The number of potential drivers increases, especially for riders closer to 101.
- Many round trips will involve pick-ups by different drivers.
Pei Zhang
Pei Zhang
ZebraNet Research

• Sparse Ad Hoc Delay-Tolerant Network:

  • Biological Goal: Track animals long-term and over long distances
    - Animal Behavior?
    - Impact of human development?

  • Engineering Goal: Sparse mobile ad hoc sensor network.
    - Fine-grain animal location
    - Pair-wise data swapping
    - Long-term operation
Built and Deployed on Poor Zebras
Fashionable
ZebraNet Deployments in Kenya

- June-July 2005
- 4 nodes
- many peer links
- 5000+ fixes
ZebraNet Impact:

- **ZebraNet Research Extensions:**
  - Delay-tolerant collaborative localization
  - Adaptive energy control

- **Beyond ZebraNet**
  - Developing Regions:
    - AIR: (Kenya)
      - Delay-tolerant collaboration to obtain voice recordings for enabling women’s contribution to community radios
    - United Village:
      - Store-and-forward for internet access
  - Sensor Networks:
    - 200+ projects in polar regions
    - Live stock tracking
    - And other CuteAnimalNets
Context-Aware Performance Support

Research issues include:

- Developing a rich model of context including the user’s goals, tasks, affordances and impediments, resources, previous actions, *et cetera* to augment the traditionally simple definition of context employed in mobile applications.
- Developing a robust approach to “plan recognition” as a user acts in the world.
- Addressing usability issues in mixed-initiative access to potentially complex performance support material on a mobile device.
- Learning and adapting to user preferences while providing performance support.
- Growing an organizational memory as a natural byproduct of work.
- Developing (or identifying/adapting) robust hardware and communications for difficult real-world work environments (e.g., an oil tanker at sea).
Dan Siewiorek
Dan Siewiorek, Asim Smailagic
Context Aware Services

• Problem being addressed
  - Use and control of information available from location and low cost sensors (accelerometers, light), to infer user environment, activities, social interactions, and needs to enable whole new classes of applications providing situationally appropriate personalized adaptive assistance. Machine learning enables customization, continued evolution and growth with individual user and experience from interaction among the user’s trusted social network.

• Relevance to Industry
  - New generation of “sticky” services that grow and evolve with the user. When the user upgrades platforms they will want to take what has been learned through experience with them

• Long-term (3-year) goals for the project
  - Modular architecture supporting incremental expansion of capabilities, user interaction design, Toolkits and several complete prototypes along with user studies to evaluate and improve serves

• Short-term goals for the project
  - One-year deliverable for the project
    • Two context aware services demonstrating the modular architecture
  - Near-term (6-month) deliverable for the project
    • Taxonomy of applications, modular architecture, and design of selected services
Context Aware Services

- **Example Potential Context Aware Services**
  - **Location based services**
    - Where are users now and where have they been (past/present) - contact/spread tracking
    - Where were users (past) - unknowing bystander
    - Where will users be (future) - crowd prediction
    - Alerts, Activity recommending
    - Location Aware Instant Messaging
    - Location specific trouble tickets
    - Resource locator
    - Location based opinion polls/voting
  - **Activity based services**
    - Matchmaker (location and interests/skills)
    - Location and activity prediction
    - Proactive help
  - **Automatic logging of activities to support health and well being**
  - **Privacy**
  - **Effects of scale**
Joy Ying Zhang
Joy Ying Zhang
Mobile Language Technologies

- New research faculty of CMU West. (joy@cs.cmu.edu)
- Language Technologies Institute, Carnegie Mellon University (www.lti.cs.cmu.edu)
  - Machine Translation
  - Information Retrieval
  - Text summarization
  - Speech Recognition/Synthesis
- InterAct (International Center for Advanced Communication Technologies) www.is.cs.cmu.edu
  - Automatic text translation
  - Speech to speech translation
  - Sign translation
PanDoRA: Large-scale Two-way Statistical Machine Translation System for Mobile Devices

- Smart engineering of the SMT system so that it can run on hand-held devices
  - Compact data structure
  - Integerized computation
  - Efficient decoding
  - Minimum on-device computation
- PanDoRA Technical Specification
  - Platform: iPaq 2750 PDA (CPU 624 Mhz, 64MB)
  - 64K Vocabulary for each language.
  - Up to 256 million unique src/tgt phrases allowed
  - Up to 4 billion phrase pairs allowed
- Statistical Machine Translation
  - Translation models trained from bilingual corpus
  - Current languages:
    - Chinese/English/Japanese/Spanish/Thai/Iraqi/Taglog ...
Sign Translation

- Automatic detect text area in captured image (Yang, Gao and Zhang 2001)
- Optical character recognition (OCR): picture to text
- OCR error correction as a translation task (Chang, Zhang and Yang 2006)
- Apply machine translation on foreign text (PanDoRA engine)
Ongoing and Future Research

- Speech translation system for cellphones: Symbian OS, RIM Blackberry, and iPhone.
- Lecture/teleconference speech translation
- Next generation translation technology: statistical modeling of meaning
- Language learning on mobile devices
- Currently funded by DARPA and NSF (GALE, TransTac projects)
  - Seeking collaborations with industrial partners to promote civilian applications
Ray Bareiss
Context-Aware Performance Support
The Mobile Repairman
Ray Bareiss

- Original research: proactive, context-aware performance support for performance of complex computer-based tasks (e.g., the Air Campaign Planning Advisor)

- A New direction: supporting mobile workers engaged in complex tasks in the physical world, e.g., repairmen
  - Typically work alone
  - Must repair a range of complex devices
  - Providing just-in-time access to factual information, as well as standardized procedures, expert help, and advice can help with focus, reduce cognitive load, and improve performance
  - System should anticipate information, resource, and tool needs
  - Cost of sending help is high
  - Typically no organizational mechanism for sharing best practices and lessons learned.

An extreme case: A ship’s engineer at sea
Context-Aware Performance Support
Research issues include:

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- Developing a robust approach to “plan recognition” as a user acts in the world
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- Learning and adapting to user preferences while providing performance support
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Norman Sadeh
Norman Sadeh
Mobile Commerce Lab

- Founded in 2001
  - 15 core members, including 5 with PhD degrees

- Sponsored Research
  - Government: NSF, ARO, DARPA, EU Commission
  - Industry: IBM, Nokia, FranceTelecom, Fujitsu, HP, etc

- Education:
  - Graduate level courses, learning-by-doing project courses, and executive education since 2001
  - Approaching a total of 1,000 students since 2001
Research Projects

• MyCampus: Enhancing Everyday Campus Life through Mobile, Context-Aware Services

• User-Controlllable Security and Privacy for Mobile and Pervasive Computing
User-Controllable Security and Privacy

• Acceptance of most applications hinges on the ability to adequately capture user privacy and security concerns

• User policies are often complex
  - Dependent on a number of contextual attributes
  - …and evolve over time
  - One size fits all doesn’t apply

• Tradeoffs between accuracy and user burden
People Finder Architecture

- Combines GPS, GSM and WiFi
- Available on cell phones and laptops
- PEA = Policy Enforcing Agent
- Policies represented in rule extension of OWL language
Overall Approach

Policy Creation

My colleagues can see my location on weekdays between 8am and 5pm

Jane

Policy Enforcement

Jane and Eric are late for our meeting. Show me where they are!

Bob

Policy Auditing & Refinement

Jane is in Oakland but I can’t access Eric’s location

Bob’s Phone

Time

Why couldn’t Bob see where I was?

Eric

Why couldn’t Bob see where I was?

Bob is a colleague. So far only your friends can see where you are

Bob is a colleague. So far only your friends can see where you are

Eric

What if my colleagues could see my location too?

In the past you denied access to your colleague Steve

OK, make it just my superiors

Eric

New Technology

Policy Visualization

Policy Enforcing Engines

Explanation

Dialog

Learning from the past

Carnegie Mellon West
Developing Software Leaders
PeopleFinder

- Piloted with close to 100 users in the Spring and Summer of 2007
- Version now available on FaceBook
- Works with J2ME phones, Windows Mobile phones, WiFi-enabled laptops (both PCs and Macs)
- Includes sophisticated policy authoring and auditing functionality
- Machine learning and explanation functionality
- Poster/demo by Jialiu Lin (CSD PhD student) later today
Tony Wasserman
Tony Wasserman
Research Interests

• Application Development Methods and Tools for Mobile Apps
• Use of Open Source Components for Development and Deployment
• Issues: Usability, scalability, web apps

Open source, toolkits, mobile platforms
Khalid Al’Ali
Founded in 2003, CMIL identifies, researches, tests, and matures forward-looking ground, air, and space technologies with applications to mobile vehicles.

CMIL is renowned for its work on advanced aircraft and spacecraft control systems, intelligent avionics, novel power systems, planetary rovers and robots, spacecraft and autonomous vehicles for lunar, Martian and Antarctic missions.

“Our lab operates like a think tank for low-cost, high performance small, unmanned vehicles – spacecraft, landers, rovers, and aerial vehicles.”
Award-Winning Research Faculty

DR. JASON LOHN, Senior Research Scientist at CMU, designed award-winning Evolved Antennas that flew on recent NASA spacecraft.

DR. A. SCOTT HOWE specializes in construction robotics for planetary surface and orbital space.
Award-Winning Research Faculty

- COREY IPPOLITO, with over ten years experience in control systems design, is the Lead Engineer on the Ames’ Exploration Aerial Vehicles (EAV).

- DR. ABE ISHIHARA, Research Engineer at CMU, is highly experienced in the areas of Surface Electromyography (EMG) and specializes in the area of Neural Networks and Metrics Driven Adaptive Control.

- RITCHIE LEE, Research Engineer at CMU, comes from a broad background in robotics spanning land, air, sea, and space. His work focuses on Micro Vehicle Technology Research.
• **Plug and Play Control via Polymorphic Computing**
 • Applications to plug and play avionics.
  - Micro Vehicle Technology Research
  - SmartLander Project Research
  - EAV Research
 • Leverages NASA and CMU technologies, research and resources, including:
  - Polymorphic Control Systems (PCS),
  - Avionics, Sensors
  - Control System Design and Simulation
  - Advanced spacecraft design, guidance, and control with a focus on low-cost access to space.
Award Winning Research

MAX 5.0J and MAX 5.0A at the NASA Ames Mars Yard

MAX Rover Simulation

Shuttle Docking Simulation

Truss design using Transformable Robotic Infrastructure-Generating Object Network (TRIGON)

http://cmil.west.cmu.edu