



Posters and Demonstrations

Healthgear: A real-time sleep apnea detection and monitoring system on a mobile phone

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Microsoft

MPTrain: A music and physiology-based personal trainer on a mobile phone

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Sensors and Surveys: Collecting Qualitative and Quantitative Data on Human Attitudes, Behaviors, and Activities via Mobile Phones

Jon Froehlich, Mike Y. Chen, Sunny Consolvo, Beverly Harrison, James A. Landay
UW Computer Science & Engineering and Intel Research Seattle

UbiFit Garden: Using persuasive technology to encourage physical activity

Sunny Consolvo, David McDonald, Beverly Harrison, James Landay
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Quicken Health and User Centered Design

Joshua Vaughn, Sara Sazegari
Intuit

SexINFO: A text messaging service for San Francisco youth

Deb Levine, Andrew Woodruff
Internet Sexuality Information Services

HCI for Clinical Decisions in Neuro-Ophthalmology

Shyh-Yuan "Sean" Kung, Ph.D.
Stanford University Medical Media and Information Technologies

Wireless Pervasive Health Monitoring

Reza Naima, John Canny
UC Berkeley

IBM Healthcare Projects

AALIM: Diagnostic Decision Support for Cardiologists

Tanveer Syeda-Madmood, David Beymer
IBM Almaden Research Center

IBM's Eclipse Open Healthcare Framework

Eishay Smith, Matthew Davis
IBM Almaden Research Center

Reaching depressed teens with computer art therapy in a virtual world: A mental health research project

Ginger Wallace, Rob Johnson
IBM Corporation

Increasing understanding of Unified Modeling Language models through transformation: ibm.com Fusion model as a case study

Robert C. Johnson, Ph.D., Gregory T. Bender, Ph.D, Anthony D. Hall, Ph.D.
IBM Corporation

Almaden USER Group Projects

Personal Information Environments

Jeffrey Pierce
IBM Almaden Research Center

Koala: Social Scripting for the Web

Tessa A. Lau, Allen Cypher, Greg Little, James Lin, Eben M. Haber, and Eser Kandogan
IBM Almaden Research Center

Shapewriter

Shumin Zhai
IBM Almaden Research Center



Healthgear: A real-time sleep apnea detection and monitoring system on a mobile phone

Nuria Oliver

Microsoft

We present HealthGear, a real-time wearable system for monitoring, visualizing and analyzing physiological signals. HealthGear consists of a set of non-invasive physiological sensors wirelessly connected via Bluetooth to a cell phone which stores, transmits and analyzes the physiological data, and presents it to the user in an intelligible way. In this poster, we focus on an implementation of HealthGear using a blood oximeter to monitor the user's blood oxygen level and pulse while sleeping. We also describe two different algorithms for automatically detecting sleep apnea events, and illustrate the performance of the overall system in a sleep study with 20 volunteers. In addition, one of the most powerful aspects of HealthGear is that it enables daily monitoring at home. A few long-term sleep studies (from weeks to 2.5 months at a time) allowed us to investigate interesting correlations between lifestyle and quality of sleep.

Posters and Demonstrations

MPTrain: A music and physiology-based personal trainer on a mobile phone

Nuria Oliver

Microsoft

We present MPTrain, a mobile phone based system that takes advantage of the influence of music in exercise performance, enabling users to more easily achieve their exercise goals. MPTrain is designed as a mobile and personal system (hardware and software) that users wear while exercising (walking, jogging or running). MPTrain's hardware includes a set of physiological sensors wirelessly connected to a mobile phone carried by the user. MPTrain's software allows the user to enter a desired exercise pattern (in terms of desired heart-rate over time) and assists the user in achieving his/her exercising goals by: (1) constantly monitoring the user's physiology (heart-rate in number of beats per minute) and movement (speed in number of steps per minute); and (2) selecting and playing music with specific features that will encourage the user to speed up, slow down or keep the pace to be on track with his/her exercise goals. The system was validated on a 9-week runner study, where participants ran with MPTrain for up to four 42-minute sessions. The runner study corroborated three hypotheses that we were interested in exploring: The MPTrain system (1) significantly improved the ability of runners to achieve the predefined workout goal, (2) made the experience more enjoyable and (3) increased the runners' perception of the workout's efficacy.



Sensors and Surveys: Collecting Qualitative and Quantitative Data on Human Attitudes, Behaviors, and Activities via Mobile Phones

Jon Froehlich, Mike Y. Chen, Sunny Consolvo, Beverly Harrison,
James A. Landay

UW Computer Science & Engineering and Intel Research Seattle

Context-aware mobile computing has enormous potential to impact healthcare. For example, research applications are being developed to predict an elder's likelihood for falling based on real-time gait measurements or automatically infer a user's level of fitness activity based on wearable sensors and machine inference. Such systems, however, are challenging to design, build and evaluate. Often, initial studies must be conducted to collect ground truth data to inform the machine learning and inference algorithms (e.g., how does jogging, bicycling, and stair climbing manifest itself in a belt-worn accelerometer?). Once these algorithms have been constructed, the applications which use them must be evaluated in an ecologically valid way (i.e., outside of the laboratory).

MyExperience is an open source tool for mobile phones, which combines sensing, machine inference, and self-report to collect both qualitative and quantitative data on human behaviors, attitudes and technology usage in the field. It supports both formative and evaluative studies within the context-aware computing design process. MyExperience has been used in a range of health-related studies including: (1) investigating the use of wearable activity-inference devices and mobile phone technology to promote physical activity; (2) using wearable heart rate variability monitors to trigger mobile therapy sessions related to stress and/or anger management; and (3) a preliminary obesity study looking at the correspondence between sensor measured physical activity and geospatial location. In addition, we are currently working with the rehabilitative medicine department at the University of Washington to study how activity levels affect pain and fatigue.

MyExperience provides access to over 140 sensor events including device usage (e.g., open applications, buttons pressed), communication (e.g., phone calls, SMS), user context (e.g., calendar appointments), and the environment (e.g., location). Other sensors can easily be added via our plug-in architecture—for example, study #2 above developed a sensor to interface with a Bluetooth-based heart rate sensor and Intel Research has developed a set of sensors to interface with their Bluetooth-enabled Mobile Sensing Platform (MSP). Sensor data is automatically time stamped and logged to a database local to the device. The sensor events themselves can be used to trigger custom actions such as wireless database synchronization, sensor throttling and in situ self-report surveys. MyExperience has been designed to run on a subject's personal phone thereby eliminating the need to carry a specialized data collection device.

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Posters and Demonstrations

MyExperience's in situ self-report surveys can be time based or sensor-triggered and are specified via an XML interface. The surveys may be used as a substitute for physical sensor data (e.g., asking users for their location rather than requiring them to carry a GPS unit), to acquire ground truth via in situ labeling, or to gather data on imperceptible details such as the user's beliefs, feelings, or attitudes. To decrease user burden, self-report sampling strategies can be dynamically modified throughout the course of a study (e.g., diminishing the number of self-report triggers in areas enough data has been gathered). Moreover, depending on the cell phone's data plan and hardware capabilities, real time updates on participation can be sent to researchers via text messaging, WiFi, or GPRS.

MyExperience has been open sourced under the BSD license (<http://myexperience.sourceforge.net>).



UbiFit Garden: Using persuasive technology to encourage physical activity

Sunny Consolvo, Beverly Harrison, James Landay, David McDonald

UW Computer Science & Engineering and Intel Research Seattle

Regular physical activity is critical to everyone's physical and psychological health, regardless of their being normal weight, overweight, or obese. Physical activity reduces the risk of premature mortality, coronary heart disease, type II diabetes, colon cancer, osteoporosis, and hypertension. It also improves symptoms associated with mental health conditions such as depression and anxiety. When combined with healthy eating habits, regular physical activity prevents overweight and obesity and can facilitate weight loss. Physical inactivity, however, negatively impacts health, by shortening or decreasing quality of life and limiting functional independence due to its role in diseases and conditions such as cardiovascular disease, obesity, type II diabetes, osteoporosis, mental health disorders, and some cancers. Yet despite the importance of regular physical activity, rates of physical inactivity are skyrocketing, as are the associated costs of caring for the myriad health problems to which they contribute. In 2003, only one-third of U.S. adults engaged in regular, leisure-time physical activity.

We are exploring how mobile computing devices with embedded sensing that are capable of inferring a range of human activities can be used to encourage individuals to be physically active. These mobile computing devices will soon be small and inexpensive enough to be used throughout everyday life. To explore opportunities and challenges of using such devices, we present a prototype system, UbiFit Garden, that explores how on-body sensing and personal, mobile displays can encourage personal reflection and gently persuade individuals to incorporate physical activity into their everyday lives. UbiFit Garden's target audience includes individuals who are motivated to incorporate regular physical activity into their everyday lives, have the ability and desire to do so, yet have not done so, or at least not done so consistently.

With UbiFit Garden, as an individual performs physical activities throughout the week, a garden blooms on the background screen of her mobile phone. Upon reaching her weekly goal, a butterfly appears. Smaller butterflies in her garden remind her of goals she met recently. Because UbiFit Garden uses the background screen of the individual's mobile phone, she is subtly reminded whenever and wherever she uses her phone of important information about her behavior. It also provides an often seen, yet subtle reminder of the commitment she made to be more active.

Posters and Demonstrations

Quicken Health and User Centered Design

Joshua Vaughn, Sara Sazegari

Intuit

What inspired Intuit to enter the healthcare arena? Applying a user-centered design approach, we started out by thinking, “What would happen if we took a proven development process, focused on what consumers really do, associated that with a trusted brand, and applied it to healthcare?” The journey began close to home for Dan Robinson, an engineering manager on the Quicken development team whose son developed a rare illness requiring a lot of medical attention. As the parent of a child with a serious medical condition, Dan experienced firsthand how stressful managing medical expenses can be. Dan’s experience inspired Quicken Medical Expense Manager, a desktop application. The premise was simple: It would track consumers’ health care expenses and help them reconcile the ‘Explanation of Benefits’ from their insurance plans with the bills from their healthcare providers. With the release of Quicken Medical Expense Manager, Intuit received attention from health plans that were interested in collaborating which lead to relationships and a new web application.

Although the Quicken Medical Expense Manager desktop application attracted a small but loyal customer base, most people are unwilling to enter the information from all of their ‘Explanation of Benefits’ into their computers by hand. The new Quicken Health web application is expected to solve this problem by downloading the information from users’ ‘Explanation of Benefits’ directly from their insurance company. Quicken Health is designed to help users verify their medical expenses, resolve insurance disputes, and get reimbursed.

We will discuss the evolution of Intuit’s entrance into the healthcare arena, along with the research methodologies and practices we employed from the exploratory research phase through development. We began with informational ethnographic in-home visits and moved through concept testing, participatory design sessions, low-fidelity scenario base prototypes, high-fidelity prototypes with users’ real data, and we are quickly approaching a Beta release to a select group of customers. We will be visiting users in their homes to observe their first experience with the product. This research effort will be exploratory and will take on a longitudinal nature. These users have agreed to visits every three months for a nine month period. We will also provide a “sneak preview” of the Quicken Health web application’s user interface.



SexINFO: A text messaging service for San Francisco youth

Deb Levine, Andrew Woodruff

Internet Sexuality Information Services

In 2005, in response to the trends of rising HIV and other sexually transmitted diseases (STD) rates and increasing cell phone use among young people, ISIS developed SexINFO, a sexual health text messaging program. SexINFO is targeted to African-American youth in San Francisco neighborhoods who have the highest risk in the city of contracting a new STD. Accessed by text-ing "SEXINFO" to 61827 from any wireless phone, information provided answers common questions of youth, such as, "What if I'm not sure I want to have sex?" and "What should I do if the condom broke?"

The service is "opt-in": Once a person texts in, they get a directory with codes instructing them to: "Text B2 if u think ur pregnant," "Text D4 to find out about HIV," or "Text F8 if ur not sure u want to have sex." No diagnoses are made over the system; instead all messaging includes basic STD/HIV info and referrals to local resources for in-person consultation. There is a companion website, www.sexttext.org where parents and others can look at the messages available to youth via their phones.

Posters and Demonstrations

HCI for Clinical Decisions in Neuro-Ophthalmology

Shyh-Yuan "Sean" Kung, Ph.D.

Stanford University Medical Media and Information Technologies

A prototype was created to develop an effective Human Computer Interface (HCI) for studying clinical decisions in Neuro-Ophthalmology was prototyped. It is based on the MESHBASE[1] graphics engine for smart 3D objects to demonstrate solutions to the following questions:

1. How can content sensitive HCI be created for an easy interactive environment?
2. How can decision trees and their distributed information in various media formats be effectively displayed and navigated?
3. How can 3D HCI be cost-effective? How can it facilitate communication between software engineers and domain experts?
4. How can HCI be sustained by a domain expert?



Wireless Pervasive Health Monitoring

Reza Naima, John Canny

UC Berkeley

We have developed a very small (1.4"x1.8") chest worn device capable of measuring several key health parameters for extended periods of time including ECG, EMG, GSR, body temperature, breathing sounds, and motion. The device is capable of storing this data on a removable flash card, detecting acute events and sending out notifications via a Bluetooth DUN interface using the user's cell phone, as well as using the Bluetooth interface to synchronize data with the user's personal computer. We hope this functionality will aid in long term health care, provide better feedback for ongoing treatments, as well as detect and notify emergency personnel in the event of a serious condition such as a heart attack or a fall. We also expect to be able to use this device to conduct new studies such as the long term effects of stress.

Posters and Demonstrations

AALIM: Diagnostic Decision Support for Cardiologists

Tanveer Syeda-Madmood, David Beymer

IBM Almaden Research Center

In current clinical practice, physicians diagnose based on evidence from a single patient and their own prior experience. What if physicians could leverage the experience of their peers who have looked at similar patients? What if they could exploit diagnostic patterns from similar patient statistics?

AALIM is a decision support system that analyzes multiple modalities to identify similar patient records to aid diagnostic decision support. It then aggregates their associated disease labels to form statistical summaries. Sophisticated feature extraction and search techniques have been developed to find similar patients based on a disease-specific analysis of their heart sounds, ECGs, and echocardiogram videos. In this presentation, we will show a video giving an overview of AALIM and some of its matching technology. We will then show a demonstration of AALIM being used as a service within EMR systems for physicians to get consensus opinions from their peers. Decision support tools such as AALIM can help physicians make more informed diagnosis in the future, thereby leading to improved quality of care for patients.



IBM's Eclipse Open Healthcare Framework

Eishay Smith, Matthew Davis

IBM Almaden Research Center

The Eclipse Open Healthcare Framework (OHF) is a project within Eclipse formed for the purpose of expediting healthcare informatics technology. The project is composed of extensible frameworks and tools which emphasize the use of existing and emerging standards in order to encourage interoperable open source infrastructure, thereby lowering integration barriers. We currently provide tools and Frameworks for HL7, IHE, Terminology, Devices, and Public Healthcare Maintenance.

In the demo we will show two OHF components: STEM and the IHE Interoperability plugins at work.

Posters and Demonstrations

Reaching depressed teens with computer art therapy in a virtual world: A mental health research project

Ginger Wallace, Robert Johnson, Ph.D.

IBM Corporation

This poster describes a proposed thesis project to assess the effectiveness of treating teen depression with art therapy conducted in a computer-mediated environment. Supported by an art therapist, tech savvy depressed teens will create sculptures, movies, computer collages, computer drawings, dress their avatars, and create environments using a private Second Life area. The teens and therapist will come together online at a certain time of day to reflect on the artwork as a group.

This poster will cover a summary of the methods of art therapy, the depressed teen population, in-progress research design, computer mediation alternatives and the 3D virtual world approach that will be taken for the art therapy. It will close with ethical questions, art therapy methodological technique comparisons, crisis intervention concerns, licensing questions, and skills questions that moving to a virtual world computer mediated approach raises.



Increasing understanding of Unified Modeling Language models through transformation: ibm.com Fusion model as a case study

Robert Johnson, Ph.D., Gregory Bender, Ph.D, Anthony Hall, Ph.D.

IBM Corporation

Models are simplifications of reality that help us understand and shape both a problem and its solutions and to comprehend large, complex systems that we could not otherwise understand as a whole (Galic, et al., 2004). The Unified Modeling Language (UML) is a powerful tool used to document analysis and design models, but it is not uncommon for only parts an organization to adopt the use of UML, meaning that the semantics and implications of the UML model must be understood by team members who do not have the skills or processes to interpret or directly reuse models. If skills and processes to directly use models do not exist in an organization, transforming the model contents into forms that can be utilized can help gain benefit from the modeling investment. This poster describes a case study of extracting value from a cross-domain model created for the ibm.com organization.

The ibm.com organization has invested in the development of a cross-domain analysis model of user roles, goals, and use cases relevant to ibm.com from a user's perspective. The "Fusion" model is the result of collaboration across divisions in developing a unified view of our domain based on user research and strategy reports. To increase the use of our model assets, our team has developed a number of ways to transform the model in order to get feedback from stakeholders and end users, increase understanding within the organization, and increase the probability that insights from the model will impact actual designs for the website, moving the organization in a direction of model-driven design.

This poster outlines the transformation methods we have used, including:

- Guided walkthrough of the goal model with users for detailed feedback on its elements and relationships
- Visualization of key elements and relationships in the goal model to promote a holistic understanding and to enable what-if variations of emphasis in the goals on the site
- Automated production of model documentation in html
- Automated production of tables summarizing details of the elements and relationships in html
- Creation of high level abstract design specifications for specific projects
- Meta analyses to design directions
- Mapping known elements from the web site against the more abstract goal and object model to make elements more tangible

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Posters and Demonstrations

The poster illustrates a current project in which we are repurposing the Fusion model by mining the information that emerges from not just the model elements, but the connections between model elements, in order to outline navigation paths that should be made available on the website. It summarizes the technique and shows examples of the intermediary tables and final output. This poster will be informative to anyone who is interested in model driven design, increasing the value of UML models in an organization, or innovative ways to reuse model artifacts.



Personal Information Environments

Jeffrey Pierce

IBM Almaden Research Center

While today's users work with and encounter a growing number and variety of computing devices (desktop PCs, laptops, tablets, PDAs, cellphones, etc.), continued adherence to the model of working with a single, personal computer has resulted in little support for coordinating activities across those devices. In fact, most devices are still completely unaware that a user might own other devices. In the Personal Information Environments project we are exploring how to support the shift from working with a single personal computer to working with a heterogeneous collection of personal computing devices. We are researching opportunities and challenges for interaction spanning multiple devices; designing an infrastructure for facilitating exploration of the design space for multi-device interaction; and creating possible point designs.

Posters and Demonstrations

Koala: Social Scripting for the Web

Tessa A. Lau, Allen Cypher, Greg Little, James Lin, Eben M. Haber, and Eser Kandogan

IBM Almaden Research Center

Knowledge capture and reuse is an ongoing challenge. Employees often struggle to find out how to complete processes such as hiring summer interns or ordering a new computer; consumers struggle with tasks such as printing digital photos or ordering prescription refills online. In our Koala project, we are exploiting the synergy of four related technologies to build a system that enables end users to document, share, and collaborate on “how to” knowledge. Koala combines ideas from programming by demonstration, “sloppy” programming, wikis, and user-specific data into a system that lets users easily record and play back scripts for tasks performed on the web. Our approach is based on a human- and machine-understandable “sloppy” programming language that can be easily read and written by people, and yet also interpreted by machine to automate common or difficult tasks. Scripts are published to a central server, in which we are exploring the broader issues of social search and navigation, and script reuse and maintenance.



Shapewriter

Shumin Zhai

IBM Almaden Research Center

In healthcare settings, computing and communication often need to take place off the desktop, in the form of tablets, handsets and other mobile devices. Text and command input on these devices, however, has always been a bottleneck to the information flow on these devices. In this poster/demo we will demonstrate ShapeWriter, an advanced mobile text input solution developed at IBM Almaden. Shape writing uses single strokes on soft keyboards to efficiently represent and enter entire words and commands. It addresses and reconciles the multiple and often conflicting requirements for mobile input including mobility, fluency, fun, initial ease of use and eventual high performance.

Posters and Demonstrations

Notes