Massachusetts Institute of Technology

Media Lab

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Many of the MIT Media Lab research projects described in the following pages are conducted under the auspices of member-supported, interdisciplinary Media Lab centers, consortia, joint research programs, and initiatives. They are:

Autism & Communication Technology Initiative
The Autism & Communication Technology Initiative utilizes the unique features of the Media Lab to foster the development of innovative technologies that can enhance and accelerate the pace of autism research and therapy. Researchers are especially invested in creating technologies that promote communication and independent living by enabling non-autistic people to understand the ways autistic people are trying to communicate; improving autistic people's ability to use receptive and expressive language along with other means of functional, non-verbal expression; and providing telemetric support that reduces reliance on caregivers' physical proximity, yet still enables enriching and natural connectivity as wanted and needed.

CE 2.0
Most of us are awash in consumer electronics (CE) devices: from cell phones, to TVs, to dishwashers. They provide us with information, entertainment, and communications, and assist us in accomplishing our daily tasks. Unfortunately, most are not as helpful as they could and should be; for the most part, they are dumb, unaware of us or our situations, and often difficult to use. In addition, most CE devices cannot communicate with our other devices, even when such communication and collaboration would be of great help. The Consumer Electronics 2.0 initiative (CE 2.0) is a collaboration between the Media Lab and its sponsor companies to formulate the principles for a new generation of consumer electronics that are highly connected, seamlessly interoperable, situation-aware, and radically simpler to use. Our goal is to show that as computing and communication capability seep into more of our everyday devices, these devices do not have to become more confusing and complex, but rather can become more intelligent in a cooperative and user-friendly way.

Center for Civic Media
Communities need information to make decisions and take action: to provide aid to neighbors in need, to purchase an environmentally sustainable product and shun a wasteful one, to choose leaders on local and global scales. Communities are also rich repositories of information and knowledge, and often develop their own innovative tools and practices for information sharing. Existing systems to inform communities are changing rapidly, and new ecosystems are emerging where old distinctions like writer/audience and journalist/amateur have collapsed. The Civic Media group is a partnership between the MIT Media Lab and Comparative Media Studies at MIT. Together, we work to understand these new ecosystems and to build tools and systems that help communities collect and share information and connect that information to action. We work closely with communities to understand their needs and strengths, and to develop useful tools together using collaborative design principles. We particularly focus on tools that can help amplify the voices of communities often excluded from the digital public sphere and connect them with new audiences, as well as on systems that help us understand media ecologies, augment civic participation, and foster digital inclusion.

Center for Future Storytelling
The Center for Future Storytelling at the Media Lab is rethinking storytelling for the 21st century. The Center takes a new and dynamic approach to how we tell our stories, creating new methods, technologies, and learning programs that recognize and respond to the changing communications landscape. The Center builds on the Media Lab's more than 25 years of experience in developing society-changing technologies for human expression and interactivity. By applying leading-edge technologies to make stories more interactive, improvisational, and social, researchers are working to transform audiences into active participants in the storytelling process, bridging the real and virtual worlds, and allowing everyone to make and share their own unique stories. Research also explores ways to revolutionize imaging and display technologies, including developing next-generation cameras and programmable studios, making movie production more versatile and economic.

Center for Mobile Learning
The Center for Mobile Learning invents and studies new mobile technologies to promote learning anywhere anytime for anyone. The Center focuses on mobile tools that empower learners to think creatively, collaborate broadly, and develop applications that are useful to themselves and others around them. The Center's work covers location-aware learning applications, mobile sensing and data collection, augmented reality gaming, and other educational uses of mobile technologies. The Center’s first major activity will focus on App Inventor, a programming system that makes it easy for learners to create mobile apps by fitting together puzzle piece-shaped “blocks” in a web browser.

Communications Futures Program
The Communications Futures Program conducts research on industry dynamics, technology opportunities, and regulatory issues that form the basis for communications endeavors of all kinds, from telephony to RFID tags. The program operates through a series of working groups led jointly by MIT researchers and industry collaborators. It is highly participatory, and its agenda reflects the interests of member companies that include both traditional stakeholders and innovators. It is jointly directed by Dave Clark (CSAIL), Charles Fine (Sloan School of Management), and Andrew Lippman (Media Lab).

Connection Science and Engineering
Our lives have been transformed by networks that combine people and computers in new ways. They have revolutionized the nature of the economy, business, government, politics, and our day-to-day existence. But there is little understanding of the fundamental nature of these networks precisely because the combination of human and technological elements poses a host of conceptual and empirical challenges. Our goal is to forge the foundations of an integrated framework for understanding the connected world we live in. This requires a multidisciplinary, interdepartmental effort that leverages and supports existing disciplinary network projects. The Center is jointly directed by Asu Ozdaglar (EECS) and Alex 'Sandy' Pentland.

The most current information about our research is available on the MIT Media Lab Web site, at http://www.media.mit.edu/research/.

Consumer Electronics Laboratory
The Consumer Electronics Laboratory provides a unique research environment to explore ideas, make things, and innovate in new directions for consumer products and services. Research projects, which span the entire Media Lab and beyond, focus on: innovative materials and design/fabrication methods for them; new power technologies; new sensors, actuators, and displays; self-managing, incrementally and limitlessly scalable ecosystems of smart devices; cooperative wireless communications; co-evolution of devices and content; and user experience. An overarching theme that runs through all the work is the co-evolution of design principles and technological discoveries, resulting in simple, ubiquitous, easy- and delightful-to-use devices that know a great deal about one another, the world, and the people in their proximity.

Digital Life
Digital Life consortium activities engage virtually the entire faculty of the Media Lab around the theme of "open innovation." Researchers divide the topic into three areas: open communications, open knowledge, and open everything. The first explores the design and scalability of agile, grassroots communications systems that incorporate a growing understanding of emergent social behaviors in a digital world; the second considers a cognitive architecture that can support many features of "human intelligent thinking" and its expressive and economic use; and the third extends the idea of inclusive design to immersive, affective, and biological interfaces and actions.

Things That Think
Things That Think is inventing the future of digitally augmented objects and environments. Toward this end, Things That Think researchers are developing sophisticated sensing and computational architectures for networks of everyday things; designing seamless interfaces that bridge the digital and physical worlds while meeting the human need for creative expression; and creating an understanding of context and affect that helps things "think" at a much deeper level. Things That Think projects under way at the Lab range from inventing the city car of the future to designing a prosthesis with the ability to help a person or machine read social-emotional cues—research that will create the technologies and tools to redefine the products and services of tomorrow.

V. Michael Bove Jr.—Object-Based Media

How sensing, understanding, and new interface technologies can change everyday life, the ways in which we communicate with one another, storytelling, and entertainment.

1. Calliope

Edwina Portocarrero

Calliope is the follow-up to the NeverEnding Drawing Machine. A portable, paper-based platform for interactive story making, it allows physical editing of shared digital media at a distance. The system is composed of a network of creation stations that seamlessly blend analog and digital media. Calliope documents and displays the creative process with no need to interact directly with a computer. By using human-readable tags and allowing any object to be used as material for creation, it offers opportunities for cross-cultural and cross-generational collaboration among peers with expertise in different media.

2. Consumer Holo-Video

V. Michael Bove Jr., James D. Barabas, Sundeep Jolly and Daniel E. Smalley

The goal of this project, building upon work begun by Stephen Benton and the Spatial Imaging group, is to create an inexpensive desktop monitor for a PC or game console that displays holographic video images in real time, suitable for entertainment, engineering, or medical imaging. To date, we have demonstrated the fast rendering of holo-video images (including stereographic images that unlike ordinary stereograms have focusing consistent with depth information) from OpenGL databases on off-the-shelf PC graphics cards; current research addresses new optoelectronic architectures to reduce the size and manufacturing cost of the display system.

Alumni Contributor: Quinn Y J Smithwick

3. Direct Fringe Writing of Computer-Generated Holograms

V. Michael Bove Jr., Sundeep Jolly and University of Arizona College of Optical Sciences

Photorefractive polymer has many attractive properties for dynamic holographic displays; however, the current display systems based around its use involve generating holograms by optical interference methods that complicate the optical and computational architectures of the systems and limit the kinds of holograms that can be displayed. We are developing a system to write diffraction fringes directly, resulting in displays with reduced footprint and cost, and potentially higher perceptual quality.

4. Everything Tells a Story

V. Michael Bove Jr., David Cranor and Edwina Portocarrero

Following upon work begun in the Graspables project, we are exploring what happens when a wide range of everyday consumer products can sense, interpret into human terms (using pattern recognition methods), and retain memories, such that users can construct a narrative with the aid of the recollections of the "diaries" of their sporting equipment, luggage, furniture, toys, and other items with which they interact.

5. Guided-Wave Light Modulator

V. Michael Bove Jr., Daniel Smalley and Quinn Smithwick

We are developing inexpensive, efficient, high-bandwidth light modulators based on lithium niobate guided-wave technology. These modulators are suitable for demanding, specialized applications such as holographic video displays, as well as other light modulation uses such as compact video projectors.

6. Infinity-by-Nine

V. Michael Bove Jr. and Daniel Novy

We expand the home-video viewing experience by generating imagery to extend the TV screen and give the impression that the scene wraps completely around the viewer. Optical flow, color analysis, and heuristics extrapolate beyond the screen edge, where projectors provide the viewer's perceptual vision with low-detail dynamic patterns that are perceptually consistent with the video imagery and increase the sense of immersive presence and participation. We perform this processing in real time using standard microprocessors and GPUs.

7. Narratarium

V. Michael Bove Jr., Catherine Havasi, Katherine (Kasia) Hayden, Daniel Novy, Jie Qi and Robert H. Speer

NEW LISTING

Remember telling scary stories in the dark with flashlights? Narratarium is an immersive storytelling environment to augment creative play using texture, color, and image. We are using natural language processing to listen to and understand stories being told and thematically augment the environment using color and images. As a child tells stories about a jungle, the room is filled with greens and browns and foliage comes into view. A traveling parent can tell a story to a child and fill to room with images, color, and presence.

8. NeverEnding Drawing Machine

Edwina Portocarrero, V. Michael Bove Jr., Cynthia Breazeal, Glorianna Davenport, David Robert, Edwina Portocarrero, Sean Follmer and Michelle Chung

Inspired by the Surrealists' Exquisite Corpse art game, the NeverEnding Drawing project is one of several applications developed on a scalable architecture and platform for collaborative creativity. Users co-create and edit each other's augmented sketchbooks in real time. By tracking individual pages of each live sketchbook, the system loads the appropriate background audiovisual content and enables users to add to it using a variety of real materials and means of mark-making. Users take pictures and record sounds to be sent back and forth between collaborators on the network. Additionally, the live sketchbooks facilitate non-linear, asynchronous access to the evolving, co-created content through their physical editing interface. By using crayons, colored pens, and various tactile and light-diffusing materials, the analog/digital hybrid model of content creation requires no expertise and creates a safe environment for sharing unfinished work with others.

9. ProtoTouch: Multitouch Interfaces to Everyday Objects

V. Michael Bove Jr. and David Cranor

An assortment of everyday objects is given the ability to understand multitouch gestures of the sort used in mobile-device user interfaces, enabling people to use such increasingly familiar gestures to control a variety of objects, and to "copy" and "paste" configurations and other information among them.

10. ShakeOnIt

V. Michael Bove Jr. and David Cranor

We are exploring ways to encode information exchange into preexisting natural interaction patterns, both between people and between a single user and objects with which he or she interacts on a regular basis. Two devices are presented to provoke thoughts regarding these information interchange modalities: a pair of gloves that requires two users to complete a "secret handshake" in order to gain shared access to restricted information, and a doorknob that recognizes the grasp of a user and becomes operational if the person attempting to use it is authorized to do so.

11. Simple Spectral Sensing

Andrew Bardagjy

NEW LISTING

The availability of cheap LEDs and diode lasers in a variety of wavelengths enables creation of simple and cheap spectroscopic sensors for specific tasks such as food shopping and preparation, healthcare sensing, material identification, and detection of contaminants or adulterants.

12. Slam Force Net

V. Michael Bove Jr., Santiago Alfaro and Daniel Novy

A basketball net incorporates segments of conductive fiber whose resistance changes with degree of stretch. By measuring this resistance over time, hardware associated with this net can calculate force and speed of a basketball traveling through the net. Applications include training, toys that indicate the force and speed on a display, “dunk competitions,” and augmented reality effects on television broadcasts. This net is far less expensive and more robust than other approaches to measuring data about the ball (e.g., photosensors or ultrasonic sensors) and doesn’t require a physical change to the hoop or backboard other than providing electrical connections to the net. Another application of the material is a flat net that can measure velocity of a ball hit or pitched into it (as in baseball or tennis), and can measure position as well (e.g., for determining whether a practice baseball pitch would have been a strike).

13. SurroundVision

V. Michael Bove Jr. and Santiago Alfaro

Adding augmented reality to the living room TV, we are exploring the technical and creative implications of using a mobile phone or tablet (and possibly also dedicated devices like toys) as a controllable "second screen" for enhancing television viewing. Thus, a viewer could use the phone to look beyond the edges of the television to see the audience for a studio-based program, to pan around a sporting event, to take snapshots for a scavenger hunt, or to simulate binoculars to zoom in on a part of the scene. Recent developments include the creation of a mobile device app for Apple products and user studies involving several genres of broadcast television programming.

14. The "Bar of Soap": Grasp-Based Interfaces

V. Michael Bove Jr. and Brandon Taylor

We have built several handheld devices that combine grasp and orientation sensing with pattern recognition in order to provide highly intelligent user interfaces. The Bar of Soap is a handheld device that senses the pattern of touch and orientation when it is held, and reconfigures to become one of a variety of devices, such as phone, camera, remote control, PDA, or game machine. Pattern-recognition techniques allow the device to infer the user's intention based on grasp. Another example is a baseball that determines a user's pitching style as an input to a video game.

15. Vision-Based Interfaces for Mobile Devices

V. Michael Bove Jr. and Santiago Alfaro

Mobile devices with cameras have enough processing power to do simple machine-vision tasks, and we are exploring how this capability can enable new user interfaces to applications. Examples include dialing someone by pointing the camera at the person's photograph, or using the camera as an input to allow navigating virtual spaces larger than the device's screen.

Ed Boyden—Synthetic Neurobiology

How to engineer intelligent neurotechnologies to repair pathology, augment cognition, and reveal insights into the human condition.

16. Direct Engineering and Testing of Novel Therapeutic Platforms for Treatment of Brain Disorders

Ed Boyden, Gilberto Abram, Leah Acker, Zack Anderson, Xue Han, Mike Henninger, Margaret Kim, Ekavali Mishra and Fumi Yoshida

New technologies for controlling neural circuit dynamics, or entering information into the nervous system, may be capable of serving in therapeutic roles for improving the health of human patients–enabling the restoration of lost senses, the control of aberrant or pathological neural dynamics, and the augmentation of neural circuit computation, through prosthetic means. We are assessing the translational possibilities opened up by our technologies, exploring the safety and efficacy of optogenetic neuromodulation in multiple animal models, and also pursuing, both in our group and in collaborations with others, proofs-of-principle of new kinds of optical neural control prosthetic. By combining observation of brain activity with real-time analysis and responsive optical neurostimulation, new kinds of "brain co-processor" may be possible which can work efficaciously with the brain to augment its computational abilities, e.g., in the context of cognitive, emotional, sensory, or motor disability.

17. Exploratory Technologies for Understanding Neural Circuits

Ed Boyden, Brian Allen, Rachel Bandler, Steve Bates, Suhasa Kodandaramaiah and Aimei Yang

We are continually exploring new strategies for understanding neural circuits, often in collaboration with other scientific, engineering, and biology research groups. If you would like to collaborate on such a project, please contact us.

18. Hardware and Systems for Control of Neural Circuits with Light

Ed Boyden, Claire Ahn, Brian Allen, Michael Baratta, Jake Bernstein, Stephanie Chan, Brian Chow, August Dietrich, Alexander Guerra, Mike Henninger, Emily Ko, Alex Rodriguez, Jorg Scholvin, Giovanni Talei Franzesi, Ash Turza, Christian Wentz and Anthony Zo

The brain is a densely wired, heterogeneous circuit made out of thousands of different kinds of cell. Over the last several years we have developed a set of "optogenetic" reagents, fully genetically encoded reagents that, when targeted to specific cells, enable their physiology to be controlled via light. To confront the 3D complexity of the living brain, enabling the analysis of the circuits that causally drive or support specific neural computations and behaviors, our lab and our collaborators have developed hardware for delivery of light into the brain, enabling control of complexly shaped neural circuits, as well as the ability to combinatorially activate and silence neural activity in distributed neural circuits. We anticipate that these tools will enable the systematic analysis of the brain circuits that mechanistically and causally contribute to specific behaviors and pathologies.

19. Molecular Reagents Enabling Control of Neurons and Biological Functions with Light

Ed Boyden, Yongku Cho, Brian Chow, Amy Chuong, Allison Dobry, Xue Han, Nathan Klapoetke, Albert Kwon, Mingjie Li, Zhilin Liu, Tania Morimoto, Xiaofeng Qian, Daniel Schmidt and Aimei Yang

Over the last several years our lab and our collaborators have pioneered a new area–the development of a number of fully genetically encoded reagents that, when targeted to specific cells, enable their physiology to be controlled via light. These reagents, known as optogenetic tools, enable temporally precise control of neural electrical activity, cellular signaling, and other high-speed natural as well as synthetic biology processes and pathways using light. Such tools are now in widespread use in neuroscience, for the study of the neuron types and activity patterns that mechanistically and causally contribute to processes ranging from cognition to emotion to movement, and to brain disorders. These tools are also being evaluated as components of prototype neural control devices for ultra-precise treatment of intractable brain disorders.

20. Recording and Data-Analysis Technologies for Observing and Analyzing Neural Circuit Dynamics

Ed Boyden, Brian Allen, Scott Arfin, Jake Bernstein, Brian Chow, Mike Henninger, Justin Kinney, Suhasa Kodandaramaiah, Caroline Moore-Kochlacs, Jorg Scholvin, Annabelle Singer, Al Strelzoff, Giovanni Talei Franzesi, Ash Turza, Christian Wentz and Alex Wis

The brain is a 3D, densely wired circuit that computes via large sets of widely distributed neurons interacting at fast timescales. In order to understand the brain, ideally it would be possible to observe the activity of many neurons with as great a degree of precision as possible, so as to understand the neural codes and dynamics that are produced by the circuits of the brain. With collaborators, our lab is developing innovations to enable such analyses of neural circuit dynamics. Such neural observation strategies may also serve as detailed biomarkers of brain disorders, or indicators of potential drug side effects. Finally, such technologies may, in conjunction with optogenetics, enable closed-loop neural control technologies, which can introduce information into the brain as a function of brain state ("brain co-processors"), enabling new kinds of circuit characterization tools, as well as new kinds of advanced brain-repair prostheses.

21. Understanding Neural Circuit Computations and Finding New TherapeuticTargets

Ed Boyden, Leah Acker, Brian Allen, Michael Baratta, Steve Bates, Jake Bernstein, Gary Brenner, Tim Buschman, Huayu Ding, Xue Han, Kyungman Kim, Suhasa Kodandaramaiah, Pei-Ann Lin, Patrick Monahan, Caroline Moore-Kochlacs, Masaaki Ogawa and Sunanda Sharma

We are using our tools–such as optogenetic neural control and brain circuit dynamics measurement–both within our lab and in collaborations with others, to analyze how specific sets of circuit elements within neural circuits give rise to behaviors and functions such as cognition, emotion, movement, and sensation. We are also determining which neural circuit elements can initiate or sustain pathological brain states. Principles of controlling brain circuits may yield fundamental insights into how best to go about treating brain disorders. Finally, we are screening for neural circuit targets that, when altered, present potential therapeutic benefits, and which may serve as potential drug targets or electrical stimulation targets. In this way we hope to explore systematic, causal, temporally precise analyses of how neural circuits function, yielding both fundamental scientific insights and important clinically relevant principles.

Cynthia Breazeal—Personal Robots

How to build socially engaging robots and interactive technologies that provide people with long-term social and emotional support to help people live healthier lives, connect with others, and learn better.

22. 3DprintedClock

Cynthia Breazeal, Peter Schmitt and Robert Swartz

The 3DprintedClock project is the result of ready-assembled 3D printed computational mechanisms, and is related to research in the fields of rapid prototyping and digital fabrication. The clock was modeled in CAD software after an existing clock, and uses a weight and a pendulum to keep track of time. The CAD model was created according to the specifications of the 3D printer, assuring sufficient gaps and clearances for the different parts. In addition, support material, drainage, and perforations were added to allow for excess support material being removed after printing. The 3DprintedClock is intended to demonstrate the superior capabilities of 3D printing as a fabrication process. It should contribute toward the future use of 3D printers to replace injection molding and expensive tooling processes, and allow for on demand, customized, and “greener” consumer products.

Alumni Contributor: William J. Mitchell

23. AIDA: Affective Intelligent Driving Agent

Cynthia Breazeal and Kenton Williams

Humans are fundamentally social animals. Why not design cars to leverage this natural propensity for social interaction and understanding? We are working with Audi and the SENSEable City Lab to redefine the relationship between car, driver, and passengers. We are currently developing a new type of in-car system that acts as a partner or friend, providing important information, and intelligently responding to the mood and behavior of the driver.

24. Cloud-HRI

Cynthia Breazeal, Nicholas DePalma, Adam Setapen and Sonia Chernova

Imagine opening your eyes and being awake for only a half an hour at a time. This is the life that robots traditionally live. This is due to a number of factors such as battery life and wear on prototype joints. Roboticists have typically muddled though this challenge by crafting handmade models of the world or performing machine learning with synthetic data–and sometimes real-world

data. While robotics researchers have traditionally used large distributed systems to do perception, planning, and learning, cloud-based robotics aims to link all of a robot's experiences. This movement aims to build large-scale machine learning algorithms that use experience from large groups of people, whether sourced from a large number of tabletop robots or a large number of experiences with virtual agents. Large-scale robotics aims to change embodied AI as it changed non-embodied AI.

25. Crowdsourcing Human-Robot Interaction: Online Game to Study Collaborative Human Behavior

Cynthia Breazeal, Jason Alonso and Sonia Chernova

Many new applications for robots require them to work alongside people as capable members of human-robot teams. We have developed Mars Escape, a two-player online game designed to study how humans engage in teamwork, coordination, and interaction. Data gathered from hundreds of online games is being used to develop computational models of human collaborative behavior in order to create an autonomous robot capable of acting as a reliable human teammate. In the summer of 2010, we will recreate the Mars Escape game in real life at the Boston Museum of Science and invite museum visitors to perform collaborative tasks together with the autonomous MDS robot Nexi.

26. DragonBot

Adam Setapen, Natalie Freed, and Cynthia Breazeal

DragonBot is a new platform built to support long-term interactions between children and robots. The robot runs entirely on an Android cell phone, which displays an animated virtual face. Additionally, the phone provides sensory input (camera and microphone) and fully controls the actuation of the robot (motors and speakers). Most importantly, the phone always has an Internet connection, so a robot can harness cloud-computing paradigms to learn from the collective interactions of multiple robots. To support long-term interactions, DragonBot is a "blended-reality" character–if you remove the phone from the robot, a virtual avatar appears on the screen and the user can still interact with the virtual character on the go. Costing less than $1,000, DragonBot was specifically designed to be a low-cost platform that can support longitudinal human-robot interactions "in the wild."

27. Exploring the Dynamics of Human-Robot Collaboration

Cynthia Breazeal, Sigurdur Orn Adalgeirsson, Nicholas Brian DePalma, Jin Joo Lee, Philipp Robbel; Alborz Geramifard, Jon How, Julie Shah (CSAIL); Malte Jung and Pamela Hinds (Stanford)

As robots become more and more capable, we will begin to invite them into our daily lives. There have been few examples of mobile robots able to carry out everyday tasks alongside humans. Though research on this topic is becoming more and more prevalent, we are just now beginning to understand what it means to collaborate. This project aims to unravel the dynamics involved in taking on leadership roles in collaborative tasks as well as balancing and maintaining the expectations of each member of the group (whether it be robot or human). This challenge involves aspects of inferring internal human state, role support and planning, as well as optimizing and keeping synchrony amongst team members "tight" in their collaboration.

Alumni Contributors: Matthew Berlin and Jesse Gray

28. Kombusto

Adam Setapen, Natalie Freed, and Cynthia Breazeal

Kombusto is the second character built around the DragonBot platform.

29. Le Fonduephone

Natalie Freed, Adam Setapen, David Robert and Cynthia Breazeal

Young children learn language not through listening alone, but through active communication with a social actor. Cultural immersion and context are also key in long-term language development. We are developing a robotic conversational partner and a hybrid physical/digital environment for second language learning. In "Le Fonduephone," a young child learns French by sitting down at a cafe table with a plush robotic character and ordering food together. The table is situated within a projected virtual environment that provides an animated backdrop. The character models how to order food and as the child practices the new vocabulary, the food is delivered via projections onto the table's surface. Meanwhile, a teacher observes the interaction remotely via a virtual representation of the cafe and can adjust the robot's conversation and behavior to support the learner.

30. NeverEnding Drawing Machine

Edwina Portocarrero, V. Michael Bove Jr., Cynthia Breazeal, Glorianna Davenport, David Robert, Edwina Portocarrero, Sean Follmer and Michelle Chung

Inspired by the Surrealists' Exquisite Corpse art game, the NeverEnding Drawing project is one of several applications developed on a scalable architecture and platform for collaborative creativity. Users co-create and edit each other's augmented sketchbooks in real time. By tracking individual pages of each live sketchbook, the system loads the appropriate background audiovisual content and enables users to add to it using a variety of real materials and means of mark-making. Users

take pictures and record sounds to be sent back and forth between collaborators on the network. Additionally, the live sketchbooks facilitate non-linear, asynchronous access to the evolving, co-created content through their physical editing interface. By using crayons, colored pens, and various tactile and light-diffusing materials, the analog/digital hybrid model of content creation requires no expertise and creates a safe environment for sharing unfinished work with others.

31. Nimbus

Adam Setapen and Cynthia Breazeal

Nimbus is the first character built around the DragonBot platform, as an exploration into fabricating a believable and "cute" robotic character for children. Through building Nimbus, we learned many new techniques for creating lifelike characters around a robot's physical limitations and advantages. Many furry prototypes were made to support "squash-and-stretch"–the most important principle of animation that can bring inanimate characters to life. Also, fabric-based capacitive sensing was sewn into the fur, so Nimbus can detect when and where he is being touched. Nimbus was made completely in-house, using diverse fabrication techniques ranging from hand-machining mechanical linkages to designing and printing custom 3D parts.

32. originalMachines

Cynthia Breazeal and Peter Schmitt

The digital revolution has fundamentally changed our lives. Multimedia content-creation tools allow us to instantiate and share ideas easily, but most outcomes only exist on-screen and online--the physical world and everyday objects are largely excluded from a parallel explosion of mechatronic object creation. Services like Ponoko and Shapeways allow professionals and non-professionals to access computer-aided manufacturing (CAM) tools like 3D-printing and laser-cutting, but there are few (if any) design tools for creating complex mechanical assemblies that take full advantage of CAM systems. Creating unique mechatronic artifacts–Original Machines–thus requires more specific and sophisticated design tools than exist today. Object-oriented mechatronics is a parametric design approach that connects knowledge about mechanical assemblies and electronics with the requirements of digital manufacturing processes. The approach addresses the missing link between accessible rapid-manufacturing services and currently available design tools, creating new opportunities for self-expression through mechatronic objects and machines.

33. plywoodServo

Cynthia Breazeal, Peter Schmitt and Susanne Seitinger

Animated artifacts require many different electronic and mechanical components, as well as appropriate drive software. This complexity has led to a kit-of-parts thinking in designing robotic assemblies, enabling more people to engage with animated devices. However, these robotics kits provide designers with a series of given constraints; the resulting black box becomes a form factor around which design is created rather than an integral part of the completed artifact, and these devices lack the specificity and material diversity of traditionally crafted artifacts. Many rapid prototyping tools propagate the same logic; for example, laser cutters are more frequently used to build casings that hide embedded mechanics and electronics than components that celebrate them. PlywoodServo considers a holistic approach to the design of animated artifacts in order to recapture the magic of engaging with their mechanical and electronic components together.

Alumni Contributor: William J. Mitchell

34. Robotic Textiles

Cynthia Breazeal and Adam Whiton

We are investigating e-textiles and fiber-electronics to develop unique soft-architecture robotic components. We have been developing large area force sensors utilizing quantum tunneling composites integrated into textiles creating fabrics that can cover the body/surface of the robot and sense touch. By using e-textiles we shift from the metaphor of a sensing skin, often used in robotics, to one of sensing clothing. We incorporated apparel design and construction techniques to develop modular e-textile surfaces that can be easily attached to a robot and integrated into a robotic system. Adding new abilities to a robot system can become as simple as changing their clothes. Our goal is to study social touch interaction and communication between people and robots while exploring the benefits of textiles and the textile aesthetic.

35. Storytelling in the Preschool of Future

Ryan Wistort

Using the Preschool of the Future environment, children can create stories that come to life in the real world. We are developing interfaces that enable children to author stories in the physical environment—stories where robots are the characters and children are not only the observers, but also the choreographers and actors in the stories. To do this, children author stories and robot behaviors using a simple digital painting interface. By combining the physical affordances of painting with digital media and robotic characters, stories can come to life in the real world. Programming in this environment becomes a group activity when multiple children use these tangible interfaces to program advanced robot behaviors.

36. The Alphabots

Cynthia Breazeal, Natalie Anne Freed, David Robert and Adam Michael Setapen

The Alphabots are trans-fictional(xF) mobile and modular semi-autonomous robotic symbol set characters designed to play with preschool aged children (three to six years old). In support of early development goals (literacy, numeracy and shape recognition) educators and parents can take an active role in co-designing playful learning interactions both on and off-screen.

37. TinkRBook

Cynthia Breazeal and Angela Chang

TinkRBook is a storytelling system that introduces a new concept of reading, called textual tinkerability. Textual tinkerability uses storytelling gestures to expose the text-concept relationships within a scene. Tinkerability prompts readers to become more physically active and expressive as they explore concepts in reading together. TinkRBooks are interactive storybooks that prompt interactivity in a subtle way, enhancing communication between parents and children during shared picture-book reading. TinkRBooks encourage positive reading behaviors in emergent literacy: parents act out the story to control the words on-screen, demonstrating print referencing and dialogic questioning techniques. Young children actively explore the abstract relationship between printed words and their meanings, even before this relationship is properly understood. By making story elements alterable within a narrative, readers can learn to read by playing with how word choices impact the storytelling experience. Recently, this research has been applied to developing countries.

38. Zipperbot: Robotic Continuous Closure for Fabric Edge Joining

NEW LISTING

Cynthia Breazeal and Adam Whiton

In robotics, the emerging field of electronic textiles and fiber-electronics represents a shift in morphology from hard and rigid mechatronic components toward a soft-architecture–and more specifically, a flexible planar surface morphology. It is thus essential to determine how a robotic system might actuate flexible surfaces for donning and doffing actions. Zipperbot is a robotic continuous closure system for joining fabrics and textiles. By augmenting traditional apparel closure techniques and hardware with robotic attributes, we can incorporate these into robotic systems for surface manipulation. Through actuating closures, textiles could shape shift or self-assemble into a variety of forms.

Leah Buechley—High-Low Tech

How to engage diverse audiences in creating their own technology by situating computation in new contexts and building tools to democratize engineering.

39. Animated Vines

Leah Buechley, Jie Qi and Adrian Melia

Animated Vines is an interactive paper installation that comes to life in the presence of a viewer. Normally a static wall hanging, as the viewer approaches the vines begin to curl and slither up and down. Each vine is made up of eight units, and each unit actuated to curl using muscle wire sewn directly to the paper. While a single unit can only curl slightly, cascading the units sums the individual movements to create a lifelike dance. The muscle wires' movements are silent so that the interaction is accompanied only by the sound of gently crackling and creaking paper.

40. Circuit Sketchbook

NEW LISTING

Leah Buechley and Jie Qi

The Circuit Sketchbook is a primer on creating expressive electronics using paper-based circuits. Inside are explanations of useful components with example circuits, as well as methods for crafting DIY switches and sensors from paper. There are also circuit templates for building functional electronics directly on the pages of the book.

41. Codeable Objects

NEW LISTING

Jennifer Jacobs and Leah Buechley

Codeable Objects is a library for Processing that allows people to design and build objects using geometry and programing. Geometric computation offers a host of powerful design techniques, but its use is limited to individuals with a significant amount of programming experience or access to complex design software. In contrast, Codeable objects allows a range of people, including novice coders, designers and artists to rapidly design, customize and construct an artifact using geometric computation and digital fabrication. The programming methods provided by the library allow the user to program a wide range of structures and designs with simple code and geometry. When the user compiles their code, the software outputs tool paths based on their specifications, which can be used in conjunction with digital fabrication tools to build their object.

42. Computational Textiles Curriculum

Leah Buechley and Kanjun Qiu

NEW LISTING

The Computational Textiles Curriculum is a collection of projects that leverages the creativity and beauty inherent in e-textiles to create an introductory computer-science curriculum for middle- and high-school students. The curriculum is taught through a sequence of hands-on project explorations of increasing difficulty, with each new project introducing new concepts in computer science, ranging from basic control flow and abstraction to more complex ideas such as networking, data processing, and algorithms. Additionally, the curriculum introduces unique methods of working with the LilyPad Arduino, creating non-traditional projects such as a game controller, a networked fabric piano, an activity monitor, or a gesture recognition glove. The projects are validated, calibrated, and evaluated through a series of workshops with middle- and high-school youth in the Boston area.

43. DIY Cellphone

David A. Mellis and Leah Buechley

NEW LISTING

An exploration into the possibilities for individual construction and customization of the most ubiquitous of electronic devices, the cellphone. By creating and sharing open-source designs for the phone's circuit board and case, we hope to encourage a proliferation of personalized and diverse mobile phones. Freed from the constraints of mass production, we plan to explore diverse materials, shapes, and functions. We hope that the project will help us explore and expand the limits of do-it-yourself (DIY) practice. How close can a homemade project come to the design of a cutting-edge device? What are the economics of building a high-tech device in small quantities? Which parts are even available to individual consumers? What's required for people to customize and build their own devices?

44. Exploring Artisanal Technology

Leah Buechley, Sam Jacoby and David A. Mellis

NEW LISTING

We are exploring the methods by which traditional artisans construct new electronic technologies using contextually novel materials and processes, incorporating wood, textiles, reclaimed and recycled products, as well as conventional circuitry. Such artisanal technologies often address different needs, and are radically different in form and function than conventionally designed and produced products.

45. Getting Hands-On with Soft Circuits

Leah Buechley and Emily Marie Lovell

Getting Hands-On with Soft Circuits is a set of instructional materials which seeks to expose middle and high school students to the creative, expressive, and computationally engaging domain of e-textiles. Engaging in hands-on activities, such as creating soft, electronic textile (e-textile) circuits, is one promising path to building self-efficacy and scientific understanding – both of which can have a dramatic impact on diversity in the field of computing. The instructional materials include a workshop activity guide and an accompanying kit of low-cost craft and electronic components.

46. LilyPad Arduino

Leah Buechley

The LilyPad Arduino is a set of tools that empowers people to build soft, flexible, fabric-based computers. A set of sewable electronic modules enables users to blend textile craft, electrical engineering, and programming in surprising, beautiful, and novel ways. A series of workshops that employed the LilyPad have demonstrated that tools such as these, which introduce engineering from new perspectives, are capable of involving unusual and diverse groups in technology development. Ongoing research will explore how the LilyPad and similar devices can engage under-represented groups in engineering, change popular assumptions about the look and feel of technology, and spark hybrid communities that combine rich crafting traditions with high-tech materials and processes.

47. LilyPond

Emily Lovell, Leah Buechley, Kanjun Qiu and Linda Delafuente

LilyPond is a budding e-textile Web community that fosters creative collaboration through the sharing of personal projects. Home to a growing repository of skill- and project-based tutorials, LilyPond provides support for young adults who want to design and create soft, interactive circuits with the LilyPad Arduino toolkit.

48. LilyTiny

Leah Buechley and Emily Marie Lovell

NEW LISTING

The LilyTiny is a small sewable breakout board for ATtiny85 microcontrollers–devices which may be integrated into circuits to enable pre-determined interactions such as lights that flash or areas that can sense touch. The circuit board can be pre-loaded with a program, enabling students to incorporate dynamic behaviors into e-textile projects without having to know how to program microcontrollers.

49. Novel Architecture

Leah Buechley, Jie Qi and Adrian Melia

This project is an experiment in material and scale: a life-sized pop-up book that you can open up and step into, made using only cardboard, an X-acto knife, tape, and glue. Inside the book is a kinetic mural of breathing pleated flowers. As you tug on a string of beads leading from one flower, the rest come to life, moving like puppets using a series of strings attached to motors. The mural itself is drawn using conductive fabric and copper tape, which serve as both expressive and functioning traces within the circuit. Electronic components are also openly displayed and emphasized to explain the electronic workings behind the mural.

50. Open Source Consumer Electronics

David A. Mellis and Leah Buechley

We offer case studies in the ways that digital fabrication allows us to treat the designs of products as a kind of source code: files that can be freely shared, modified, and produced. In particular, the case studies combine traditional electronic circuit boards and components (a mature digital fabrication process) with laser-cut or 3D printed materials. They demonstrate numerous possibilities for individual customizations both pre- and post-fabrication, as well as a variety of potential production and distribution processes and scales.

51. Piezo Powered Tambourine

Leah Buechley and Jie Qi

An electric tambourine that is completely powered by the playing of the instrument. The jingles of the tambourine are lined with piezoelectric elements, which generate voltage when impacted. This voltage is then harvested to turn on LED lights on the tambourine. The harder the tambourine rattles, the greater the voltage generated by the piezoelectric elements and thus the brighter the light. Yellow LED lights on the jingles light up when the corresponding piezo is rattled. If the tambourine is played with enough force, blue and red LED lights on the band also light up. Thus, the player can both hear and see the music generated by this instrument.

52. Programmable Paintings

NEW LISTING

Leah Buechley and Jie Qi

Programmable Paintings are a series of artworks that use electronic elements such as LED lights and microphone sensors as "pigments" in paintings. The goal is to blend traditional elements of painting–color, texture, composition–with these electronic components to create a new genre of time-based and interactive art.

53. Self-Folding Origami Paper

Leah Buechley and Jie Qi

A first-step toward origami robotics, I/O paper is a pair of origami papers in which the red (controller) paper senses how it is being folded and the white (output) paper follows. When the white paper is flipped over, blintz folding allows the paper to get up, wobble around, and even flip itself over. The microcontroller and circuitry is on the body of the red paper and the white paper is actuated by shape memory alloy.

Catherine Havasi—Digital Intuition

How to give computers human-like intuition so they can better understand us.

54. ConceptNet

Catherine Havasi, Robert Speer, Henry Lieberman and Marvin Minsky

Imparting common-sense knowledge to computers enables a new class of intelligent applications better equipped to make sense of the everyday world and assist people with everyday tasks. Our approach to this problem is ConceptNet, a freely available common-sense knowledge base that possesses a great breadth of general knowledge that computers should already know, ready to be incorporated into applications. ConceptNet 5 is a semantic network with millions of nodes and edges, built from a variety of interlinked resources, both crowd-sourced and expert-created, including the Open Mind Common Sense corpus, WordNet, Wikipedia, and OpenCyc. It contains information in many languages including English, Chinese, Japanese, Dutch, and Portuguese, resulting from a collaboration of research projects around the world. In this newest version of ConceptNet, we aim to automatically assess the reliability of its data when it is collected from variously reliable sources and processes.

Alumni Contributors: Jason Alonso, Kenneth C. Arnold, Ian Eslick, Xinyu H. Liu and Push Singh

55. Corona

Rob Speer and Catherine Havasi

NEW LISTING

How can a knowledge base learn from the Internet, when you shouldn't trust everything you read on the Internet? CORONA is a system for building a knowledge base from a combination of reliable and unreliable sources, including crowd-sourced contributions, expert knowledge, Games with a Purpose, automatic machine reading, and even knowledge that is imperfectly derived from other knowledge in the system. It confirms knowledge as reliable as more sources confirm it or unreliable when sources disagree, and then by running the system in reverse it can discover which knowledge sources are the most trustworthy.

56. Divisi: Reasoning Over Semantic Relationships

Robert Speer, Catherine Havasi, Kenneth Arnold, and Jason Alonso

We have developed technology that enables easy analysis of semantic data, blended in various ways with common-sense world knowledge. The results support reasoning by analogy and association. A packaged library of code is being made available to all sponsors.

57. Narratarium

V. Michael Bove Jr., Catherine Havasi, Katherine (Kasia) Hayden, Daniel Novy, Jie Qi and Robert H. Speer

NEW LISTING

Remember telling scary stories in the dark with flashlights? Narratarium is an immersive storytelling environment to augment creative play using texture, color, and image. We are using natural language processing to listen to and understand stories being told and thematically augment the environment using color and images. As a child tells stories about a jungle, the room is filled with greens and browns and foliage comes into view. A traveling parent can tell a story to a child and fill to room with images, color, and presence.

58. Open Mind Common Sense

Marvin Minsky, Robert Speer, Catherine Havasi, Jason Alonso, Kenneth Arnold, Ian Eslick, Henry Lieberman, Dustin Smith and Bo Morgan

The biggest problem facing artificial intelligence today is how to teach computers enough about the everyday world so that they can reason about it like we do—so that they can develop "common sense." We think this problem may be solved by harnessing the knowledge of people on the Internet, and we have built a Web site to make it easy and fun for people to work together to give computers the millions of little pieces of ordinary knowledge that constitute "common sense." Teaching computers how to describe and reason about the world will give us exactly the technology we need to take the Internet to the next level, from a giant repository of Web pages to a new state where it can think about all the knowledge it contains; in essence, to make it a living entity.

Alumni Contributors: Jason Alonso, Kenneth C. Arnold, Ian Eslick, Henry Lieberman, Xinyu H. Liu, Bo Morgan, Push Singh and Dustin Arthur Smith

59. Red Fish, Blue Fish

Robert Speer and Catherine Havasi

With commonsense computing, we can discover trends in the topics that people are talking about right now. Red Fish Blue Fish takes input in real time from lots of political blogs, and creates a visualization of what topics are being discussed by the left and the right.

60. Semantic Synesthesia

Catherine Havasi, Jason Alonso and Robert H. Speer

Semantic Synesthesia is a program that guesses a color to represent a given input word or sentence, taking into account both physical descriptions of objects and emotional connotations. This novel application of artificial intelligence uses knowledge about the world to build a model of how people think about objects, emotions, and colors, and uses this model to guess an appropriate color for a word. Colorizer works over static text and real-time input, such as a speech recognition stream. It has applications in games, arts, and Web page design.

61. Spontaneous Location-Aware Social Networks

Catherine Havasi, Brett Samuel Lazarus and Victor J Wang

CharmMe is a mobile social discovery application that helps people meet each other during events. The application blends physical and digital proximity to help you connect with with other like-minded individuals. Armed with RFID sensors and a model of how the Lab works, CharmMe determines who you should talk to using information including checking in to conference talks or “liking” projects using QR codes. In addition, possible opening topics of conversation are suggested based on users' expressed similar interests.

62. The Glass Infrastructure

Henry Holtzman, Andy Lippman, Matthew Blackshaw, Jon Ferguson, Catherine Havasi, Julia Ma, Daniel Schultz and Polychronis Ypodimatopoulos

This project builds a social, place-based information window into the Media Lab using 30 touch-sensitive screens strategically placed throughout the physical complex and at sponsor sites. The idea is get people to talk among themselves about the work that they jointly explore in a public place. We present Lab projects as dynamically connected sets of "charms" that visitors can save, trade, and explore. The GI demonstrates a framework for an open, integrated IT system and shows new uses for it.

Alumni Contributors: Rick Borovoy, Greg Elliott and Boris Grigory Kizelshteyn

Hugh Herr—Biomechatronics

How technology can be used to enhance human physical capability.

63. Artificial Gastrocnemius

Hugh Herr and Ken Endo

Human walking neuromechanical models show how each muscle works during normal, level-ground walking. They are mainly modeled with clutches and linear springs, and are able to capture dominant normal walking behavior. This suggests to us to use a series-elastic clutch at the knee joint for below-knee amputees. We have developed the powered ankle prosthesis, which generates enough force to enable a user to walk "normally." However, amputees still have problems at the knee joint due to the lack of gastrocnemius, which works as an ankle-knee flexor and a plantar flexor. We hypothesize that metabolic cost and EMG patterns of an amputee with our powered ankle and virtual gastrocnemius will dramatically improve.

64. Biomimetic Active Prosthesis for Above-Knee Amputees

Ernesto C. Martinez-Villalpando and Hugh Herr

We propose a novel biomimetic active prosthesis for above-knee amputees. The clinical impact of this technology focuses on improving an amputee’s gait symmetry, walking speed, and metabolic energy consumption on variant terrain conditions. The electromechanical design of this robotic device mimics the body's own musculoskeletal design, using actuator technologies that have muscle-like behaviors and can integrate control methodologies that exploit the principles of human locomotion. This work seeks to advance the field of biomechatronics by contributing to the development of intelligent assistive technologies that adapt to the needs of the physically challenged.

65. Command of Powered Ankle Angle using Electromyography

Hugh Herr and Matthew Robert Williams

While the current powered ankle under development can readily adapt to constant surfaces while walking (including slopes and stairs), it is unable to predict slope transitions; particularly when the walking surface changes from a positive to a negative slope (or vice versa) within one step. This project explores to effect of using voluntary electromyography (EMG) signal from muscles in the residual limb to adjust ankle angle for better accommodation of slope transitions. Unilateral, trans-femoral amputees will walk across a course consisting of a series of changing slopes while using either a conventional prosthesis or the powered ankle with EMG commanded ankle position. It is thought that by giving the user a simple, effective, and rapid means of adjusting ankle angle, the safety and comfort of gait during rapid slope transitions can be improved.

66. Control of Muscle-Actuated Systems via Electrical Stimulation

Hugh Herr

Motivated by applications in rehabilitation and robotics, we are developing methodologies to control muscle-actuated systems via electrical stimulation. As a demonstration of such potential, we are developing centimeter-scale robotic systems that utilize muscle for actuation and glucose as a primary source of fuel. This is an interesting control problem because muscles: a) are mechanical state-dependent actuators; b) exhibit strong nonlinearities; and c) have slow time-varying properties due to fatigue-recuperation, growth-atrophy, and damage-healing cycles. We are investigating a variety of adaptive and robust control techniques to enable us to achieve trajectory tracking, as well as mechanical power-output control under sustained oscillatory conditions. To implement and test our algorithms, we developed an experimental capability that allows us to characterize and control muscle in real time, while imposing a wide variety of dynamical boundary conditions.

Alumni Contributor: Waleed A. Farahat

67. Effect of a Powered Ankle on Shock Absorption and Interfacial Pressure

Hugh Herr and David Hill

Lower-extremity amputees face a series of potentially serious post-operative complications. Among these are increased risk of further amputations, excessive stress on the unaffected and residual limbs, and discomfort at the human-prosthesis interface. Currently, conventional, passive prostheses have made strides towards alleviating the risk of experiencing complications, but we believe that the limit of “dumb” elastic prostheses has been reached; in order to make further strides we must integrate “smart” technology in the form of sensors and actuators into lower-limb prostheses. This project compares the elements of shock absorption and socket pressure between passive and active ankle-foot prostheses. It is an attempt to quantitatively evaluate the patient’s comfort.

68. Human Walking Model Predicts Joint Mechanics, Electromyography, and Mechanical Economy

Hugh Herr and Ken Endo

We are studying the mechanical behavior of leg muscles and tendons during human walking in order to motivate the design of economical robotic legs. We hypothesize that quasi-passive, series-elastic clutch units spanning the knee joint in a musculoskeletal arrangement can capture the dominant mechanical behaviors of the human knee in level-ground walking. Biarticular elements necessarily need to transfer energy from the knee joint to hip and/or ankle joints, and this mechanism would reduce the necessary muscle work and improve the mechanical economy of a human-like walking robot.

69. Load-Bearing Exoskeleton for Augmentation of Human Running

Hugh Herr, Grant Elliott and Andrew Marecki

Augmentation of human locomotion has proved an elusive goal. Natural human walking is extremely efficient and the complex articulation of the human leg poses significant engineering difficulties. We present a wearable exoskeleton designed to reduce the metabolic cost of jogging. The exoskeleton places a stiff fiberglass spring in parallel with the complete leg during stance phase, then removes it so that the knee may bend during leg swing. The result is a bouncing gait with reduced reliance on the musculature of the knee and ankle.

70. Metabolic and Biomechanical Effects of Using a Powered Prosthetic Knee

Hugh Herr and Matthew Robert Williams

Gait research on trans-femoral prosthesis users has shown that the metabolic costs for these individuals are significantly higher than those of able-bodied individuals for level-ground walking. Additionally, trans-femoral amputees exhibit a much higher degree of gait asymmetry between the affected and non-affected sides, leading to reduced walking speeds and increased hip and back pain compared to non-amputees. This project consists of a clinical study of five to ten unilateral trans-femoral amputees using either a conventional or a powered knee prosthesis and height-weight matched able-bodied individuals. This work will compare the metabolic cost of transport and biomechanics of conventional standard of care prosthetic knees with a novel powered knee. Amputee performance with each prosthesis will also be compared to the performance of able-bodied individuals. It is hypothesized by using a powered prosthetic knee both the metabolic and biomechanical aspects of amputee gait can be improved.

71. Powered Ankle-Foot Prosthesis

Hugh Herr

The human ankle provides a significant amount of net positive work during the stance period of walking, especially at moderate to fast walking speeds. Conversely, conventional ankle-foot prostheses are completely passive during stance, and consequently, cannot provide net positive work. Clinical studies indicate that transtibial amputees using conventional prostheses experience many problems during locomotion, including a high gait metabolism, a low gait speed, and gait asymmetry. Researchers believe the main cause for the observed locomotion is due to the inability of conventional prostheses to provide net positive work during stance. The objective of this project is to develop a powered ankle-foot prosthesis that is capable of providing net positive work during the stance period of walking. To this end, we are investigating the mechanical design and control system architectures for the prosthesis. We also conduct a clinical evaluation of the proposed prosthesis on different amputee participants.

Alumni Contributor: Samuel Au

72. Robotic Lower-Limb Sockets

Hugh Herr and Arthur Petron

How can socket materials selection and actuation change the way a prosthesis interacts with its user? Can a lower-limb prosthetic be made to be comfortable throughout a normal day? What about during extended periods of high activity? Current prostheses provide little in the way of adjustment to the wearer as their residual limb changes over time. Further, the most comfortable prostheses rely on custom fitting for each user. An active prosthesis can provide increased comfort to the user. Through the use of new and exciting measurement and fabrication techniques we can leverage new types of active and passive materials to make the world's most comfortable sockets.

73. Sensor-Fusions for an EMG Controlled Robotic Prosthesis

Matthew Todd Farrell and Hugh Herr

Current unmotorized prostheses do not provide adequate energy return during late stance to improve level-ground locomotion. Robotic prostheses can provide power during late-stance to improve metabolic economy in an amputee during level-ground walking. This project seeks to improve the types of terrain a robotic ankle and successfully navigate by using command signals taken from the intact and residual limbs of an amputee. By combining these commands signals with sensors attached to the robotic ankle it might be possible to further understand the role of physiological signals in the terrain adaptation of robotic ankles.

74. Variable Impedance Prosthetic (VIPr) Socket Design

Hugh Herr and David Sengeh

Today, 100 percent of amputees experience some form of prosthetic socket discomfort. This project involves the design and production of a comfortable, variable impedance prosthetic (VIPr) socket using digital anatomical data for a transtibial amputee using computer-aided design and manufacturing (CAD/CAM). The VIPr socket uses multiple materials to achieve compliance, thereby increasing socket comfort for amputees, while maintaining structural integrity. The compliant features are seamlessly integrated into the 3D printed socket to achieve lower interface peak pressures over bony protuberances and other anatomical points in comparison to a conventional socket. This lower peak pressure is achieved through a design that uses anthropomorphic data acquired through surface scan and Magnetic Resonance Imaging techniques. A mathematical transformation maps the quantitative measurements of the human residual limb to the corresponding socket shape and impedance characteristics, spatially.

Cesar Hidalgo—Macro Connections

How to transform data into knowledge.

75. Compare

Phil Salesses, Shahar Ronen, and Cesar A. Hidalgo

Which artists preceded their time? Compare aims to answer this seemingly subjective question by using crowdsourcing and ranking algorithms. Similar to its sibling project Place Pulse, Compare presents participants two paintings at a time, then asks them to pick the one that better answers a simple question, such as “which painting seems more modern?” Responses are collectively ranked to create a perception network, which is used to form a timeline of perceived dates of creation for the paintings. We then identify innovative artists by juxtaposing the perceived dates of creation with the actual ones.

76. Cultural Exports

NEW LISTING

Shahar Ronen and César A. Hidalgo

Cultural Exports introduces a new approach for studying both connections between countries and the cultural impact of countries. Consider a native of a certain country who becomes famous in other countries–this person is in a sense a "cultural export" of his home country that is "imported" to other countries. For example, the popularity of Dominican baseball player Manny Ramirez in the USA and Korea makes him a cultural export of the Dominican Republic to these countries. Using Wikipedia biographies and search-engine data, we measure the popularity of people across different countries and languages, and break it down by each person's native country, period, and occupation. This allows us to map international cultural trade and identify major exporters and importers in different fields and times, as well as hubs for cultural trade (e.g., Greece for philosophy in classical times or USA for baseball nowadays).

77. Differentia

Shahar Ronen and César A. Hidalgo

Any American can tell you the object of football is to advance an oval-shaped ball into the opponent’s end zone, but in the rest of the world football is about kicking a sphere-shaped ball into a goal. For an Englishman, dictatorship is a form of government practiced in other countries, but many Germans or South Americans experienced it first-hand. This is likely to lead to a different opinion on the subject, and we believe a better understanding of these differences would help in the bridging of cultural gaps. Differentia examines how different cultures perceive the same concepts, through analysis of the centrality of these concepts and the sentiment they draw in text corpora in different languages (e.g., Wikipedia articles).

78. Network of Languages

Shahar Ronen and César A. Hidalgo

NEW LISTING

Most interactions between cultures require overcoming a language barrier, either by learning the other culture's language or by using a third common language. Multilingual speakers thus play an important role in facilitating cross-cultural interaction. In addition, certain languages–not necessarily the most spoken ones–are more likely than others to serve as intermediary languages. The rise of online social networking services and platforms for user-generated digital content provides an opportunity for a large-scale study of lingual connections encompassing hundreds of millions of speakers all over the world. We mapped connections among over sixty languages by analyzing multilingual contributions among the authors of over a billion tweets and tens of millions of Wikipedia pages. Comparing this network of languages to real-world indicators of interaction between speakers of different languages–flights, trade, media coverage–we find the most connected languages and identify potential paths through which ideas disseminate from one culture to another.

79. Place Pulse

Phil Salesses, Anthony DeVincenzi and César A. Hidalgo

Place Pulse is a website that allows anybody to quickly run a crowdsourced study and interactively visualize the results. It works by taking a complex question, such as “Which place in Boston looks the safest?” and breaking it down into easier to answer binary pairs. Internet participants are given two images and asked "Which place looks safer?" From the responses, directed graphs are generated and can be mined, allowing the experimenter to identify interesting patterns in the data and form new hypothesis based on their observations. It works with any city or question and is highly scalable. With an increased understanding of human perception, it should be possible for calculated policy decisions to have a disproportionate impact on public opinion.

80. The Economic Complexity Observatory

Alex Simoes, Dany Bahar, Ricardo Hausmann and César A. Hidalgo

With more than six billion people and 15 billion products, the world economy is anything but simple. The Economic Complexity Observatory is an online tool that helps people explore this complexity by providing tools that can allow decision makers to understand the connections that exist between countries and the myriad of products they produce and/or export. The Economic Complexity Observatory puts at everyone’s fingertips the latest analytical tools developed to visualize and quantify the productive structure of countries and their evolution.

81. The Economic Diversity Lab

Dany Bahar, Charles Gomez, Coco Krumme, Ricardo Hausmann and César A. Hidalgo

The geographical range of modern elephants is sub-Saharan Africa, parts of India, and Southeast Asia. But what is the geographical range of motorcycle-engine factories, or leather tanneries? Evolution and natural history can help us understand the geographical range of modern elephants, but can they also help us understand why some industries occur at some places and not others? The Economic Diversity Lab studies the geographical patterns defined by economic activities and the connections of these patterns to prosperity and human well being. A joint effort with Harvard’s Center for International Development, the Economic Diversity Lab leads the development of tools that can help elucidate the origins of the geographical patterns defined by different economic activities and the coarsenss of global prosperity.

82. The Notable Network and The Connected History

César A. Hidalgo

James Watt (1736-1819), the Scottish engineer that perfected the steam engine, was a good friend of Adam Smith (1723-1790), the Scottish moral philosopher who wrote The Wealth of Nations. While both are notable historical characters, the link between them is practically unknown. Scottish philosopher David Hume (1711-1776) was also Smith’s friend, and some sources presume that he also knew Watt. These connections between notable historical characters motivate us to wonder how much their contributions were influenced by the richness of their intellectual environments and also whether intellectual enlightenments tend in general to have particular social signatures. The Notable Network project looks to map and document the connections between notable historical characters, both old and new to help develop a relational view of history to complement the atomized view.

Henry Holtzman—Information Ecology

How to create seamless and pervasive connections between our physical environments and information resources.

83. Air Mobs

Andy Lippman, Henry Holtzman and Eyal Toledano

Airmobs is a community-based P2P cross-operator WiFi tethering market. It provides network connectivity when one device has no available Internet connection or roaming costs are too high, and another device has excellent network connectivity and a full battery. Airmobs barters air time between different mobile phone users using WiFi tethering to locate and establish an internet link though another device that has a good 3G connection. The member that provides the link will gain airtime credit that can be used when he is notconnected. Airmobs creates incentive via a secondary market–a user will be willing to share his data connection since he will get data in return. The synergetic value emerges when different users on different mobile operators provide network access to each other, compensating for each operator's out-of-coverage areas.

84. Brin.gy: What Brings Us Together

Henry Holtzman, Andy Lippman and Polychronis Ypodimatopoulos

We allow people to form dynamic groups focused on topics that emerge serendipitously during everyday life. They can be long-lived or flower only for a short time. Examples include people interested in buying the same product, those with similar expertise, those in the same location, or any collection of such attributes. We call this the Human Discovery Protocol (HDP). Similar to how computers follow well-established protocols like DNS in order to find other computers that carry desired information, HDP presents an open protocol for people to announce bits of information about themselves, and have them aggregated and returned back in the form of a group of people that match against the user's specified criteria. We experiment with a web-based implementation (brin.gy) that allows users to join and communicate with groups of people based on their location, profile information, and items they may want to buy or sell.

85. CoCam

Andy Lippman, Henry Holtzman, Eyal Toledano, Dan Sawada

NEW LISTING

Collaborating and media creation are difficult tasks, both for people and for network architectures. CoCam is a self-organizing network for real-time camera image collaboration. Like all camera apps, just point and shoot; CoCam then automatically joins other media creators into a network of collaborators. Network discovery, creation, grouping, joining, and leaving is done automatically in the background, letting users focus on participation in an event. We use local P2P middleware and a 3G negotiation service to create these networks for real-time media sharing. CoCam also provides multiple views that make the media experience more exciting–such as appearing to be in multiple places at the same time. The media is immediately distributed and replicated in multiple peers, thus if a camera phone is confiscated other users have copies of the images.

86. CommenTV

Jee Yeon Hwang, Pol Pla i Conesa, Henry Holtzman and Marie-José Montpetit

CommenTV is a social commenting system for audiovisual content. CommenTV is able to take and display texts, images, and related videos as social comments.

87. Droplet

Robert Hemsley and Henry Holtzman

NEW LISTING

Droplet is a tangible interface which explores the movement of information between digital and physical representations. Through light-based communication, the project allows information to be easily extracted from its digital form behind glass and converted into mobile tangible representations thus altering its form and our perception of the information.

88. E-MotionInfo

Jee Yeon Hwang and Henry Holtzman

e-MotionInfo enables users to explore the harmonization of their movements, digital information, and responsive objects. e-MotionInfo creates links between motions, digital content, and associated objects to improve upon expressive and natural user interactions.

89. Linear Mandala

Henry Holtzman and Arlene Brigoli Ducao

NEW LISTING

In Linear Mandala, a single participant wears a custom headset outfitted with an electroencephalography (EEG) sensor. The participant walks alongside a row of monitors and speakers. Video, sound, and the physical headset are designed to support contemplation. In real time, a shadow-like avatar pushes a ball of objects representing each participant's brain activity.

The participant must maintain a consistent brain state for the avatar and ball to move forward in tandem with his physical movement.

Alumni Contributors: Matt Hirsch and Daniel E. Schultz

90. MindRider

Arlene Ducao and Henry Holtzman

MindRider is a helmet that translates electroencephalogram (EEG) feedback into an embedded LED display. For the wearer, green lights indicate a focused, active mental state, while red lights indicate drowsiness, anxiety, and other states not conducive to operating a bike or vehicle. Flashing red lights indicate extreme anxiety (panic). As many people return to cycling as a primary means of transportation, MindRider can support safety by adding visibility and increased awareness to the cyclist/motorist interaction process. In future versions, MindRider may be outfitted with an expanded set of EEG contacts, proximity sensors, non-helmet wearable visualization, and other features that will increase the cyclist's awareness of self and environment. These features may also allow for hands-free control of cycle function. A networked set of MindRiders may be useful for tracking, trauma, and disaster situations.

91. MobileP2P

Yosuke Bando, Eyal Toledano, Robert Hemsley, Mary Linnell, Dan Sawada and Henry Holtzman

NEW LISTING

MobileP2P aims to magically populate mobile devices with popular video clips and app updates without using people's data plans by opportunistically connecting nearby devices together when they are in range of each other.

92. NeXtream: Social Television

Henry Holtzman, ReeD Martin and Mike Shafran

Functionally, television content delivery has remained largely unchanged since the introduction of television networks. NeXtream explores an experience where the role of the corporate network is replaced by a social network. User interests, communities, and peers are leveraged to determine television content, combining sequences of short videos to create a set of channels customized to each user. This project creates an interface to explore television socially, connecting a user with a community through content, with varying levels of interactivity: from passively consuming a series, to actively crafting one's own television and social experience.

Alumni Contributor: Ana Luisa Santos

93. Proverbial Wallets

Henry Holtzman, John Kestner, Daniel Leithinger, Danny Bankman, Emily Tow and Jaekyung Jung

We have trouble controlling our consumer impulses, and there's a gap between our decisions and the consequences. When we pull a product off the shelf, do we know our bank-account balance, or whether we're over budget for the month? Our existing senses are inadequate to warn us. The Proverbial Wallet fosters a financial sense at the point of purchase by embodying our electronically tracked assets. We provide tactile feedback reflecting account balances, spending goals, and transactions as a visceral aid to responsible decision-making.

94. Qooqle

Li Bian and Henry Holtzman

Qooqle allows people to reshape their interactions with computing and reorganize the world’s information through their casual conversations and habitual gestures. Qooqle combines mobile, cloud, and social media to draw people closer to computing and make computers more invisible. The multi-modal user interface of Qooqle allows people to engage with one another and the information world more naturally.

95. Queen's New Clothes

Li Bian, Matt Hirsch, Lining Yao, Henry Holtzman and Hiroshi Ishii

Inspired by the Danish fairy tale "The Emperor's New Clothes" and Lady Gaga’s Orbit dress, we have designed and implemented a costume, The Queen’s New Clothes, which appears plain to the naked eye but exhibits changing patterns on photos taken at different times and locations. The process of making this costume has taken us on a journey of exploring the digital aspect and dual status of fashion, fashion as a dynamically changing and embodied visual communication tool, and the relationship between the fashion trendsetter and the audience.

96. Soundaround

Henry Holtzman, Ramesh Raskar, Matt Hirsch, Alex Olwal and Thomas A. Baran

Recently, multi-view display hardware has made compelling progress in graphics. Soundaround is a multi-viewer interactive audio system, designed to be integrated into unencumbered multi-view display systems, presenting localized audio/video channels with no need for glasses or headphones. Our technical work describes a framework for the design of multi-viewer interactive audio systems that is general and supports optimization of the system for multiple observation planes and room responses.

97. SparkInfo

Jee Yeon Hwang and Henry Holtzman

NEW LISTING

SparkInfo enables users to create, exchange and augment their audiovisual elements in ways that are personally unique and sociable. SparkInfo provides a social space for the co-creation of audiovisual and multimedia resources.

98. StackAR

Robert Hemsley and Henry Holtzman

NEW LISTING

StackAR explores the augmentation of physical objects within a digital environment by abstracting interfaces from physical to virtual implementations. StackAR is a Lilypad Arduino shield that enables capacitive touch and light base communication with a tablet. When pressed against a screen the functionality of StackAR extends into the digital environment, allowing the object to become augmented by the underlying display. This creates an augmented breadboard environment where virtual and physical components can be combined and prototyped in a more intuitive manner.

99. The Glass Infrastructure

Henry Holtzman, Andy Lippman, Matthew Blackshaw, Jon Ferguson, Catherine Havasi, Julia Ma, Daniel Schultz and Polychronis Ypodimatopoulos

This project builds a social, place-based information window into the Media Lab using 30 touch-sensitive screens strategically placed throughout the physical complex and at sponsor sites. The idea is get people to talk among themselves about the work that they jointly explore in a public place. We present Lab projects as dynamically connected sets of "charms" that visitors can save, trade, and explore. The GI demonstrates a framework for an open, integrated IT system and shows new uses for it.

Alumni Contributors: Rick Borovoy, Greg Elliott and Boris Grigory Kizelshteyn

100. Truth Goggles

Henry Holtzman and Daniel E. Schultz

Truth Goggles attempts to decrease the polarizing effect of perceived media bias by forcing people to question all sources equally by invoking fact -checking services at the point of media consumption. Readers will approach even their most trusted sources with a more critical mentality by viewing content through various "lenses" of truth.

101. Twitter Weather

Henry Holtzman, John Kestner and Stephanie Bian

The vast amounts of user-generated content on the Web produce information overload as frequently as they provide enlightenment. Twitter Weather reduces large quantities of text into meaningful data by gauging its emotional content. This Website visualizes the prevailing mood about top Twitter topics by rendering a weather-report-style display. Comment Weather is its counterpart for article comments, allowing you to gauge sentiment without leaving the page. Supporting Twitter Weather is a user-trained Web service that aggregates and visualizes attitudes on a topic.

102. Where The Hel

Henry Holtzman and Arlene Brigoli Ducao

NEW LISTING

"Where The Hel" is a pair of helmets: plain and funky. The funky helmet is 3D printed; the plain helmet visualizes proximity to the funky helmet as a function of signal strength, via an LED light strip. The funky helmet contains an Xbee and a GPS Radio. Its position is tracked via a web app. The wearer of the plain helmet can track the funky one via the web app and the LED strip on his helmet. These helmets are potential iterations towards a more developed HADR (Humanitarian Assistance and Disaster Relief) helmet system.

Hiroshi Ishii—Tangible Media

How to design seamless interfaces between humans, digital information, and the physical environment.

103. Ambient Furniture

Hiroshi Ishii, David Rose, and Shaun Salzberg

NEW LISTING

Furniture is the infrastructure for human activity. Every day we open cabinets and drawers, pull up to desks, recline in recliners, and fall into bed. How can technology augment these everyday rituals in elegant and useful ways? The Ambient Furniture project mixes apps with the IKEA catalog to make couches more relaxing, tables more conversational, desks more productive, lamps more enlightening, and beds more restful. With input from Vitra and Steelcase, we are prototyping a line of furniture to explore ideas about peripheral awareness (Google Latitude door bell), incidental gestures (Amazon restocking trash can and the Pandora lounge chair), pre-attentive processing (energy clock), and eavesdropping interfaces (FaceBook photo coffee table).

104. Amphorm

Hiroshi Ishii and David Lakatos

NEW LISTING

Shape-changing materials have been part of sci-fi literature for decades. But if tomorrow we invent them how are we going to use them? Amphorm is a kinetic sculpture that resembles a vase. Since Amphorm is a dual citizen between the digital and the physical world, its shape can be altered both in the physical world through hand gestures and in the digital realms through an iPad app. Through this project we explore how the physical world should be synchronized to the digital world and how tools from both worlds can jointly alter dual-citizens.

105. Beyond: A Collapsible Input Device for 3D Direct Manipulation

Jinha Lee and Hiroshi Ishii

Beyond is a collapsible input device for direct 3D manipulation. When pressed against a screen, Beyond collapses in the physical world and extends into the digital space of the screen, so that users have an illusion that they are inserting the tool into the virtual space. Beyond allows users to interact directly with 3D media without having to wear special glasses, avoiding inconsistencies of input and output. Users can select, draw, and sculpt in 3D virtual space, and seamlessly transition between 2D and 3D manipulation.

106. FocalSpace

Hiroshi Ishii, Anthony DeVincenzi and Lining Yao

FocalSpace is a system for focused collaboration utilizing spatial depth and directional audio. We present a space where participants, tools, and other physical objects within the space are treated as interactive objects that can be detected, selected, and augmented with metadata. Further, we demonstrate several scenarios of interaction as concrete examples. By utilizing diminishing reality to remove unwanted background surroundings through synthetic blur, the system aims to attract participant attention to foreground activity.

107. GeoSense

Hiroshi Ishii, Anthony DeVincenzi and Samuel Luescher

NEW LISTING

An open publishing platform for visualization, social sharing, and data analysis of geospatial data.

108. IdeaGarden

Hiroshi Ishii, David Lakatos, and Lining Yao

The IdeaGarden allows participants of creative activities to collectively capture, select, and share (CCSS) the stories, sketches, and ideas they produce in physical and digital spaces. The iGarden attempts to optimize the CCSS loop and to bring it from hours to seconds in order to turn asynchronous collaborative thought processes into synchronous real-time cognitive flows. The iGarden system is composed of a tangible capturing system including recording devices always "at-hand", of a selection workflow that allows the group to reflect and reduce the complexity of captured data in real-time and of a sharing module that connects socially selected information to the cloud.

Alumni Contributor: Jean-Baptiste Labrune

109. Kinected Conference

Anthony DeVincenzi, Lining Yao, Hiroshi Ishii and Ramesh Raskar

How could we enhance the experience of video-conference by utilizing an interactive display? With a Kinect camera and sound sensors, we explore how expanding a system's understanding of spatially calibrated depth and audio alongside a live video stream can generate semantically rich

three-dimensional pixels, containing information regarding their material properties and location. Four features have been implemented: Talking to Focus, Freezing Former Frames, Privacy Zone, and Spacial Augmenting Reality.

110. Meld

Hiroshi Ishii, Andy Lippman, Matthew Blackshaw, Anthony DeVincenzi and David Lakatos

Meld provides a new perspective on your social life. By presenting your social graph as a moving picture, Meld breaks free from the text-centric interfaces of today's social networks, offering a fresh, holistic perspective. Unseen trends, before lost in mountains of text, can be better understood, providing an organic and evolving view of your relationships. Meld is a semi-finalist in the MIT 100K Entrepreneurship Competition.

111. MirrorFugue

Xiao Xiao and Hiroshi Ishii

MirrorFugue is an interface for the piano that bridges the gap of location in music playing by connecting pianists in a virtual shared space reflected on the piano. Built on a previous design that only showed the hands, our new prototype displays both the hands and upper body of the pianist. MirrorFugue may be used for watching a remote or recorded performance, taking a remote lesson, and remote duet playing.

112. NeverEnding Drawing Machine

Edwina Portocarrero, V. Michael Bove Jr., Cynthia Breazeal, Glorianna Davenport, David Robert, Edwina Portocarrero, Sean Follmer and Michelle Chung

Inspired by the Surrealists' Exquisite Corpse art game, the NeverEnding Drawing project is one of several applications developed on a scalable architecture and platform for collaborative creativity. Users co-create and edit each other's augmented sketchbooks in real time. By tracking individual pages of each live sketchbook, the system loads the appropriate background audiovisual content and enables users to add to it using a variety of real materials and means of mark-making. Users take pictures and record sounds to be sent back and forth between collaborators on the network. Additionally, the live sketchbooks facilitate non-linear, asynchronous access to the evolving, co-created content through their physical editing interface. By using crayons, colored pens, and various tactile and light-diffusing materials, the analog/digital hybrid model of content creation requires no expertise and creates a safe environment for sharing unfinished work with others.

113. Peddl

Andy Lippman, Hiroshi Ishii, Matthew Blackshaw, Anthony DeVincenzi and David Lakatos

NEW LISTING

Peddl creates a localized, perfect market. All offers are broadcasts, allowing users to spot trends, bargains, and opportunities. With GPS- and Internet-enabled mobile devices in almost every pocket, we see an opportunity for a new type of marketplace which takes into account your physical location, availability, and open negotiation. Like other real-time activities, we are exploring transactions as an organizing principle among people that, like Barter, may be strong, rich, and long-lived.

114. PingPongPlusPlus

Hiroshi Ishii, Xiao Xiao, Michael Bernstein, Lining Yao, Dávid Lakatos, Kojo Acquah, Jeff Chan, Sean Follmer and Daniel Leithinger

PingPong++ (PingPongPlusPlus) builds on PingPongPlus (1998), a ping pong table that could sense ball hits, and reuse that data to control visualizations projected on the table. We have redesigned the system using open-source hardware and software platforms so that anyone in the world can build their own reactive table. We are exploring ways that people can customize their ping pong game experience. This kiosk allows players to create their own visualizations based on a set of templates. For more control of custom visualizations, we have released a software API based on the popular Processing language to enable users to write their own visualizations. We are always looking for collaborators! Visit pppp.media.mit.edu to learn more.

115. Radical Atoms

Hiroshi Ishii, Leonardo Bonanni, Keywon Chung, Sean Follmer, Jinha Lee, Daniel Leithinger and Xiao Xiao

Radical Atoms is our vision of interactions with future material.

Alumni Contributors: Keywon Chung, Adam Kumpf, Amanda Parkes, Hayes Raffle and Jamie B Zigelbaum

116. Recompose

Hiroshi Ishii, Matthew Blackshaw, Anthony DeVincenzi and David Lakatos

Human beings have long shaped the physical environment to reflect designs of form and function. As an instrument of control, the human hand remains the most fundamental interface for affecting the material world. In the wake of the digital revolution, this is changing, bringing us to reexamine tangible interfaces. What if we could now dynamically reshape, redesign, and restructure our environment using the functional nature of digital tools? To address this, we present Recompose, a framework allowing direct and gestural manipulation of our physical environment. Recompose complements the highly precise, yet concentrated affordance of direct manipulation with a set of gestures, allowing functional manipulation of an actuated surface.

117. Relief

Hiroshi Ishii and Daniel Leithinger

Relief is an actuated tabletop display, able to render and animate 3D shapes with a malleable surface. It allows users to experience and form digital models such as geographical terrain in an intuitive manner. The tabletop surface is actuated by an array of motorized pins, which can be addressed individually and sense user input like pulling and pushing. Our current research focuses on utilizing freehand gestures for interacting with content on Relief.

Alumni Contributor: Adam Kumpf

118. RopeRevolution

Jason Spingarn-Koff (MIT), Hiroshi Ishii, Sayamindu Dasgupta, Lining Yao, Nadia Cheng (MIT Mechanical Engineering) and Ostap Rudakevych (Harvard University Graduate School of Design)

Rope Revolution is a rope-based gaming system for collaborative play. After identifying popular rope games and activities from around the world, we developed a generalized tangible rope interface that includes a compact motion-sensing and force-feedback module that can be used for a variety of rope-based games, such as rope jumping, kite flying, and horseback riding. Rope Revolution is designed to foster both co-located and remote collaborative experiences by using actual rope to connect players in physical activities across virtual spaces.

119. SandScape

Carlo Ratti, Assaf Biderman and Hiroshi Ishii

SandScape is a tangible interface for designing and understanding landscapes through a variety of computational simulations using sand. The simulations are projected on the surface of a sand model representing the terrain; users can choose from a variety of different simulations highlighting height, slope, contours, shadows, drainage, or aspect of the landscape model, and alter its form by manipulating sand while seeing the resulting effects of computational analysis generated and projected on the surface of sand in real time. SandScape demonstrates an alternative form of computer interface (tangible user interface) that takes advantage of our natural abilities to understand and manipulate physical forms while still harnessing the power of computational simulation to help in our understanding of a model representation.

Alumni Contributors: Yao Wang, Jason Alonso and Ben Piper

120. Sensetable

Hiroshi Ishii

Sensetable is a system that wirelessly, quickly, and accurately tracks the positions of multiple objects on a flat display surface. The tracked objects have a digital state, which can be controlled by physically modifying them using dials or tokens. We have developed several new interaction techniques and applications on top of this platform. Our current work focuses on business supply-chain visualization using system-dynamics simulation.

Alumni Contributors: Jason Alonso, Dan Chak, Gian Antonio Pangaro, James Patten and Matt Reynolds

121. Sourcemap

Hiroshi Ishii, Leonardo Bonanni and Matthew Hockenberry

Sourcemap.com is the open directory of supply chains and environmental footprints. Consumers use the site to learn about where products come from, what they're made of, and how they impact people and the environment. Companies use Sourcemap to communicate transparently with consumers and tell the story of how products are made. Thousands of maps have already been created for food, furniture, clothing, electronics, and more. Behind the website is a revolutionary social network for supply-chain reporting. The real-time platform gathers information from every stakeholder so that–one day soon–you'll be able to scan a product on a store shelf and know exactly who made it.

122. T(ether)

Hiroshi Ishii, Andy Lippman, Matthew Blackshaw and David Lakatos

T(ether) is a novel spatially aware display that supports intuitive interaction with volumetric data. The display acts as a window affording users a perspective view of three- dimensional data through tracking of head position and orientation. T(ether) creates a 1:1 mapping between real and virtual coordinate space allowing immersive exploration of the joint domain. Our system creates a shared workspace in which co-located or remote users can collaborate in both the real and virtual worlds. The system allows input through capacitive touch on the display and a motion-tracked glove. When placed behind the display, the user's hand extends into the virtual world, enabling the user to interact with objects directly.

123. Tangible Bits

Hiroshi Ishii, Sean Follmer, Jinha Lee, Daniel Leithinger and Xiao Xiao

People have developed sophisticated skills for sensing and manipulating our physical environments, but traditional GUIs (Graphical User Interfaces) do not employ most of them. Tangible Bits builds upon these skills by giving physical form to digital information, seamlessly coupling the worlds of bits and atoms. We are designing "tangible user interfaces" that employ physical objects, surfaces, and spaces as tangible embodiments of digital information. These include foreground interactions with graspable objects and augmented surfaces, exploiting the human senses of touch and kinesthesia. We also explore background information displays that use "ambient media"—light, sound, airflow, and water movement—to communicate digitally mediated senses of activity and presence at the periphery of human awareness. We aim to change the "painted bits" of GUIs to "tangible bits," taking advantage of the richness of multimodal human senses and skills developed through our lifetimes of interaction with the physical world.

Alumni Contributors: Yao Wang, Mike Ananny, Scott Brave, Dan Chak, Angela Chang, Seung-Ho Choo, Keywon Chung, Andrew Dahley, Philipp Frei, Matthew G. Gorbet, Adam Kumpf, Jean-Baptiste Labrune, Vincent Leclerc, Jae-Chol Lee, Ali Mazalek, Gian Antonio Pangaro, Amanda Parkes, Ben Piper, Hayes Raffle, Sandia Ren, Kimiko Ryokai, Victor Su, Brygg Ullmer, Catherine Vaucelle, Craig Wisneski, Paul Yarin and Jamie B Zigelbaum

124. Topobo

Hayes Raffle, Amanda Parkes and Hiroshi Ishii

Topobo is a 3-D constructive assembly system embedded with kinetic memory—the ability to record and play back physical motion. Unique among modeling systems is Topobo's coincident physical input and output behaviors. By snapping together a combination of passive (static) and active (motorized) components, users can quickly assemble dynamic, biomorphic forms such as animals and skeletons, animate those forms by pushing, pulling, and twisting them, and observe the system repeatedly playing back those motions. For example, a dog can be constructed and then taught to gesture and walk by twisting its body and legs. The dog will then repeat those movements.

125. Video Play

Sean Follmer, Hayes Raffle and Hiroshi Ishii

Long-distance families are increasingly staying connected with free video conferencing tools. However, the tools themselves are not designed to accommodate children's or families' needs. We explore how play can be a means for communication at a distance. Our Video Play prototypes are simple video-conferencing applications built with play in mind, creating opportunities for silliness and open-ended play between adults and young children. They include simple games, such as Find It, but also shared activities like book reading, where users' videos are displayed as characters in a story book.

Alumni Contributor: Hayes Raffle

126. Wetpaint

Leonardo Bonanni, Xiao Xiao, Bianca Costanzo, Andrew Shum, Matthew Hockenberry, Maurizio Seracini and Hiroshi Ishii

The Wetpaint project investigates new interfaces for exploring the history of a work of visual art. We are seeking intuitive metaphors for touch-screen interaction, including virtually scraping through the multispectral scans of an ancient painting, and pulling, stretching, and tearing through a virtual canvas. The interaction techniques refined through Wetpaint are being built into a Web-based tool for leveraging collective intelligence toward the pursuit of art diagnostics.

Joseph M. Jacobson—Molecular Machines

How to engineer at the limits of complexity with molecular-scale parts.

127. GeneFab

Bram Sterling, Kelly Chang, Joseph M. Jacobson, Peter Carr, Brian Chow, David Sun Kong, Michael Oh and Sam Hwang

What would you like to "build with biology"? The goal of the GeneFab projects is to develop technology for the rapid fabrication of large DNA molecules, with composition specified directly by the user. Our intent is to facilitate the field of Synthetic Biology as it moves from a focus on single genes to designing complete biochemical pathways, genetic networks, and more complex systems. Sub-projects include: DNA error correction, microfluidics for high throughput gene synthesis, and genome-scale engineering (rE. coli).

Alumni Contributor: Chris Emig

128. NanoFab

Kimin Jun, Jaebum Joo and Joseph M. Jacobson

We are developing techniques to use the focused ion beam to program the fabrication of nanowires based nanostructures and logic devices.

129. Synthetic Photosynthesis

Joseph M. Jacobson and Kimin Jun

We are using nanowires to build structures for synthetic photosynthesis for the solar generation of liquid fuels.

NEW LISTING

Sepandar Kamvar—Social Computing

How to meaningfully connect people with information.

130. Jabberwocky

Sepandar Kamvar

Some of the most interesting and useful technologies of the past few years have involved large-scale coordination of people and machines. Programming languages, however, tend to focus on the machines. Traditional programming-language design assumes that people are either programmers or end-users, not members of a decentralized computing system. As a result, programming–or even thinking about–such human-machine systems is often awkward and laborious. Jabberwocky is a development stack for social computation that works to address this issue. Jabberwocky consists of Dog, a language that is intended to be executed by both computers and people, and Dormouse, a "virtual machine" layer that allows other languages and applications to be written directly to clusters of people and machines.

Kent Larson—Changing Places

How new strategies for architectural design, mobility systems, and networked intelligence can make possible dynamic, evolving places that respond to the complexities of life.

131. A Market Economy of Trips

Dimitris Papanikolaou and Kent Larson

We are developing a new strategy to create autonomous self-organizing vehicle sharing systems that uses incentive mechanisms (dynamic pricing) to smooth demand imbalances, and an interactive graphical user interface to effectively communicate location-based price information. Prices adjust dynamically to parking needs, incentivizing users to drive vehicles to stations with too few vehicles, while discouraging arrivals to stations with excess vehicles. This research explains how users make decisions in dynamically priced mobility systems, under which circumstances their actions may make up a self-regulating economy, and how this economy dynamically performs in different demand patterns. To address these issues we develop a computational framework

using system dynamics, urban economics, and game theory that models system behavior which will be used to determine optimum pricing policy, fleet size, and density of parking stations for having a stable yet profitable system.

Alumni Contributor: William J. Mitchell

132. AEVITA

Kent Larson, William Lark, Jr., Nicholas David Pennycooke and Praveen Subramani

With various private, governmental, and academic institutions researching autonomous vehicle deployment strategies, the way we think about vehicles must adapt. But what happens when the driver–the main conduit of information transaction between the vehicle and its surroundings–is removed? The living EV system aims to fill this communication void by giving the autonomous vehicle the means to sense others around it, and react to various stimuli as intuitively as possible by taking design cues from the living world. The system is comprised of various types of sensors (computer vision, UWB beacon tracking, sonar) and actuators (light, sound, mechanical) in order to express recognition of others, announce intentions, and portray the vehicle's general state. All systems are built on the second version of the half-scale CityCar concept vehicle, featuring advanced mixed-materials (CFRP + Aluminum) and a significantly more modularized architecture.

133. Autonomous Facades for Zero-Energy Urban Housing

Ronan Lonergan and Kent Larson

We are developing self-powered responsive building envelope components that efficiently integrate solar shading and heating, ventilation, privacy control, and ambient lighting. Dynamic facade modules integrate sensing systems to respond to both environmental conditions and the activities of people.

134. CityCar

Ryan C.C. Chin, William Lark, Jr., Nicholas Pennycooke, Praveen Subramani, and Kent Larson

CityCar is a foldable, electric, sharable, two-passenger vehicle for crowded cities. Wheel Robots—fully modular in-wheel electric motors—integrate drive motors, suspension, braking, and steering inside the hub-space of the wheel. This drive-by-wire system requires only data, power, and mechanical connection to the chassis. With over 80 degrees of steering freedom, Wheel Robots enable a zero-turn radius, and without the gasoline-powered engine and drive-train the CityCar can fold.We are working with Denokinn on an integrated, modular system for assembly and distribution of the CityCar. Based in Spain's Basque region, the project is called "Hiriko," which stands for Urban Car. The Hiriko project aims to create a new, distributed manufacturing system for the CityCar, enabling automotive suppliers to provide "core" components made of integrated modules such as in-wheel motor units, battery systems, interiors, vehicle control systems, vehicle chassis/exoskeleton, and glazing. (Continuing the vision of William J. Mitchell.)

Alumni Contributors: Patrik Kunzler, Philip Liang, William J. Mitchell and Raul-David Poblano

135. CityCar Folding Chassis

William Lark, Jr., Nicholas Pennycooke, Ryan C.C. Chin and Kent Larson

The CityCar folding chassis is a half-scale working prototype that consists of four independently controlled in-wheel electric motors, four-bar linkage mechanism for folding, aluminum exoskeleton, operable front ingress/egress doors, lithium-nanophosphate battery packs, vehicle controls, and a storage compartment. The folding chassis can demonstrate compact folding (3:1 ratio compared to conventional vehicles), omni-directional driving, and wireless remote controls. The half-scale mock-up explores the material character and potential manufacturing strategies that will scale to a future full-scale build. (Continuing the vision of William J. Mitchell.)

Alumni Contributors: William J. Mitchell and Raul-David Poblano

136. CityCar Half-Scale Prototype

Kent Larson, Nicholas David Pennycooke and Praveen Subramani

The CityCar half-scale prototype has been redesigned from the ground up to incorporate the latest materials and manufacturing processes, sensing technologies, battery systems, and more. This new prototype demonstrates the functional features of the CityCar at half-scale, including the folding chassis. New sensing systems have been embedded to enable research into autonomous driving and parking, while lithium batteries will provide extended range. A new control system based on microprocessors allows for faster boot time and modularity of the control system architecture.

137. CityCar Ingress-Egress Model

Kent Larson, Nicholas David Pennycooke and Praveen Subramani

The CityCar Ingress-Egress Model provides a full-scale platform for testing front ingress and egress for new vehicle types. The platform features three levels of actuation for controlling the movement of seats within a folding vehicle, and can store custom presets of seat positioning and folding process for different users.

138. CityCar Testing Platform

William Lark, Jr., Nicholas Pennycooke, Ryan C.C. Chin and Kent Larson

The CityCar Testing Platform is a full-scale and modular vehicle that consists of four independently controlled Wheel Robots, an extruded aluminum frame, battery pack, driver's interface, and seating for two. Each Wheel Robot is capable of over 120 degrees of steering freedom, thus giving the CityCar chassis omni-directional driving ability such as sideways parking, zero-radius turning, torque steering, and variable velocity (in each wheel) steering. This four-wheeler is an experimental platform for by-wire controls (non-mechanically coupled controls) for the Wheel Robots, thus allowing for the platform to be controlled by wireless joysticks. The four-wheeler also allows the CityCar design team to experiment with highly personalized body/cabin designs. (Continuing the vision of William J. Mitchell.)

Alumni Contributor: William J. Mitchell

139. CityHome

Kent Larson, Daniel Smithwick and Hasier Larrea

We demonstrate how the CityHome, which has a very small footprint (840 square feet), can function as an apartment two to three times that size. This is achieved through a transformable wall system which integrates furniture, storage, exercise equipment, lighting, office equipment, and entertainment systems. One potential scenario for the CityHome is where the bedroom transforms to a home gym, the living room to a dinner party space for 14 people, a suite for four guests, two separate office spaces plus a meeting space, or an a open loft space for a large party. Finally, the kitchen can either be open to the living space, or closed off to be used as a catering kitchen. Each occupant engages in a process to personalize the precise design of the wall units according to his or her unique activities and requirements.

140. Distinguish: Home Activity Recognition

Kent Larson

We propose a recognition system with a user-centric point of view, designed to make the activity detection processes intelligible to the end-user of the home, and to permit these users to improve recognition and customize activity models based on their particular habits and behaviors. Our system, named Distinguish, relies on high-level, common sense information to create activity models used in recognition. These models are understandable by end-users and transferable between homes. Distinguish consists of a common-sense recognition engine that can be modified by end-users using a novel phone interface.

141. FlickInk

Sheng-Ying (Aithne) Pao and Kent Larson

NEW LISTING

Have you ever been in a teleconference and found it difficult to deliver what you've been writing/sketching on paper to the remote participant? FlickInk reinvents paper/pen-based interaction and enables your notes to jump from paper to physical surroundings as well as to a remote destination. With a quick flick of the pen, it allows you to naturally "throw" your handwriting to remote collaborators whenever you're ready. While the contents are sharable in real time as you write, you maintain control of what's shared and what's private. Control over authorship and privacy is enhanced as this paper-based media comes accessible and natural in remote collaboration. Not only in the context of collaboration, FlickInk also seamlessly transfers writings/sketches on paper to specified physical objects. We aim to enhance this novel interaction to enrich highly personalized dynamic experiences for living-working space in the future.

142. Hiriko CityCar Urban Feasibility Studies

Kent Larson, Chih-Chao Chuang and Ryan C.C. Chin

NEW LISTING

We are engaging in research that may be incorporated by Denokinn into a feasibility study for Mobility-on-Demand (MoD) systems in a select number of cities, including Berlin, Barcelona, Malmo, and San Francisco. The goal of the project is to propose electric mobility car-sharing pilot programs to collaborated cities, which will work with their existing public infrastructure, use Hiriko CityCar as the primary electric vehicle, and to study how this system will work with the urbanscape and lifestyle in different cities.

143. Hiriko CityCar with Denokinn

Ryan C.C. Chin, Kent Larson, William Lark, Jr., Chih-Chao Chuang, Nicholas Pennycooke, and Praveen Subramani

We are working with Denokinn to design and develop an integrated modular system for assembly and distribution of the CityCar. This project, based in the Basque region of Spain, will be called the "Hiriko" Project, which stands for Urban Car (Hiri = urban, Ko = coche or car in Basque). The goal of the Hiriko project is to create a new, distributed manufacturing system for the CityCar which will enable automotive suppliers to provide "core" components made of integrated modules such as in-wheel motor units, battery systems, interiors, vehicle control systems, vehicle chassis/exoskeleton, and glazing. A full-scale working prototype will be completed by the end of 2011 with an additional 20 prototypes to be built for testing in 2012. (Continuing the vision of William J. Mitchell).

Alumni Contributors: William J. Mitchell and Raul-David Poblano

144. Home Genome: Mass-Personalized Housing

Daniel Smithwick and Kent Larson

The home is becoming a center for preventative health care, energy production, distributed work, and new forms of learning, entertainment, and communication. We are developing techniques for capturing and encoding concepts related to human needs, activities, values, and practices. We are investigating solutions built from an expanding set of building blocks, or “genes,” which can be combined and recombined in various ways to create a unique assembly of spaces and systems. We are developing algorithms to match individuals to design solutions in a process analogous to that used to match customer profiles to music, movies, and books, as well as new fabrication and supply-chain technologies for efficient production. We are exploring how to tap the collective intelligence of distributed groups of people and companies to create an expanding set of solutions.

145. HomeMaestro

Kent Larson, Shaun David Salzberg and Microsoft Research

NEW LISTING

Current home-automation systems offer very poor user experiences. On a superficial level, they are extremely expensive, difficult to install and use, have limited functionality, and are often proprietary. Deeper problems include the difficulty of scripting ever-changing human schedules, managing network security, and understanding and debugging artificially intelligent systems, as well as dealing with homes with multiple occupants and preferences. HomeMaestro is a home-automation system prototype that attempts to address many of these issues. It consists of two main features: a tangible scripting interface that lets users give their appliances "muscle memory" by naturally interacting with them, and an "app store" for quickly and easily downloading functionality to the home. In other words, HomeMaestro is a platform for intuitively defining home appliance behavior.

146. Intelligent Autonomous Parking Environment

Chris Post, Raul-David Poblano, Ryan C.C. Chin, and Kent Larson

In an urban environment, space is a valuable commodity. Current parking structures must allow each driver to independently navigate the parking structure to find a space. As next-generation vehicles turn more and more to drive-by-wire systems, though, direct human interaction will not be necessary for vehicle movement. An intelligent parking environment can use drive-by-wire technology to take the burden of parking away from the driver, allowing for more efficient allocation of parking resources to make urban parking less expensive. With central vehicle control, cars can block each other while parked since the parking environment can move other vehicles to enabled a blocked vehicle to leave. The parking environment can also monitor the vehicle charge, allowing intelligent and efficient utilization of charge stations by moving vehicles to and from charge stations as necessary.

147. Mass-Personalized Solutions for the Elderly

Kent Larson, Ryan C.C. Chin, Daniel John Smithwick and Tyrone L. Yang

The housing, mobility, and health needs of the elderly are diverse, but current products and services are generic, disconnected from context, difficult to access without specialized guidance, and do not anticipate changing life circumstances. We are creating a platform for delivering integrated, personalized solutions to help aging individuals remain healthy, autonomous, productive, and engaged. We are developing new ways to assess specific individual needs and create mass-customized solutions. We are also developing new systems and standards for construction that will enable the delivery of more responsive homes, products, and services; these standards will make possible cost-effective but sophisticated, interoperable building components and systems. For instance, daylighting controls will be coordinated with reconfigurable rooms and will accommodate glare sensitivity. These construction standards will enable industrial suppliers to easily upgrade and retrofit homes to better care for home occupants as their needs change over time.

148. Media Lab Energy and Charging Research Station

Praveen Subramani, Raul-David Poblano, Ryan C.C. Chin, Kent Larson and Schneider Electric

We are collaborating with Schneider Electric to develop a rapid, high-power charging station in MIT's Stata Center for researching EV rapid charging and battery storage systems for the electric grid. The system is built on a 500 kW commercial uninterruptible power supply (UPS) designed by Schneider Electric and modified by Media Lab researchers to enable rapid power transfer from lead-acid batteries in the UPS to lithium-ion batteries onboard an electric vehicle. Research experiments include: exploration of DC battery banks for intermediate energy storage between the grid and vehicles; repurposing the lead acid batteries in UPS systems with lithium-ion cells; and exploration of Level III charging connectors, wireless charging, and user-interface design for connecting the vehicles to physical infrastructure. The station is scheduled for completion by early 2012 and will be among the most advanced battery and EV charging research platforms at a university.

149. MITes+: Portable Wireless Sensors for Studying Behavior in Natural Settings

Kent Larson and Stephen Intille

MITes (MIT environmental sensors) are low-cost, wireless devices for collecting data about human behavior and the state of the environment. Nine versions of MITes have now been developed, including MITes for people movement (3-axis accelerometers), object movement (2-axis accelerometers), temperature, light levels, indoor location, ultra-violet light exposure, heart rate, haptic output, and electrical current flow. MITes are being deployed to study human behavior in natural setting. We are also developing activity recognition algorithms using MITes data for health and energy applications. (a House_n Research Consortium Initiative funded by the National Science Foundation)

Alumni Contributors: Randy Rockinson and Emmanuel Munguia Tapia

150. Mobility on Demand Systems

Kent Larson, Ryan C.C. Chin, Chih-Chao Chuang, William Lark, Jr., Brandon Phillip Martin-Anderson and SiZhi Zhou

Mobility on Demand (MoD) systems are fleets of lightweight electric vehicles at strategically distributed electrical charging stations throughout a city. MoD systems solve the “first and last mile” problem of public transit, providing mobility between transit station and home/workplace. Users swipe a membership card at the MoD station to access vehicles, which can be driven to any other station (one-way rental). The Vélib' system of 20,000+ shared bicycles in Paris is the largest and most popular one-way rental system in the world. MoD systems incorporate intelligent fleet management through sensor networks, pattern recognition, and dynamic pricing, and the benefits of Smart Grid technologies including intelligent electrical charging (including rapid charging), vehicle-to-grid (V2G), and surplus energy storage for renewable power generation and peak shaving for the local utility. We have designed three MoD vehicles: CityCar, RoboScooter, and GreenWheel bicycle. (Continuing the vision of William J. Mitchell.)

151. Open-Source Furniture

Kent Larson

We are exploring the use of parametric design tools and CNC fabrication technology to enable lay people to navigate through a complex furniture and cabinetry design process for office and residential applications. We are also exploring the integration of sensors, lighting, and actuators into furniture to create objects that are responsive to human activity.

152. Operator

Kent Larson and Brandon Phillip Martin-Anderson

Operator is an AI agent that keeps tabs on how things are running around town, and tells you how to get where you want to go in the least effortful of ways.

153. PlaceLab and BoxLab

Jason Nawyn, Stephen Intille and Kent Larson

The PlaceLab was a highly instrumented, apartment-scale, shared research facility where new technologies and design concepts were tested and evaluated in the context of everyday living. It was used by researchers until 2008 to collect fine-grained human behavior and environmental data, and to systematically test and evaluate strategies and technologies for the home in a natural setting with volunteer occupants. BoxLab is a portable version with many of the data collection capabilities of PlaceLab. BoxLab can be deployed in any home or workplace. (A House_n Research Consortium project funded by the National Science Foundation.)

Alumni Contributors: Jennifer Suzanne Beaudin, Manu Gupta, Pallavi Kaushik, Aydin Oztoprak, Randy Rockinson and Emmanuel Munguia Tapia

154. Reinventing Mobility

Kent Larson and Sandra Richter

NEW LISTING

By 2050, 70 percent of the world's population is projected to live in cities. The number of cars will increase from about one billion to a projected four billion by 2050, and with it the carbon footprint. Mobility on demand addresses these challenges, reducing the number of cars in cities; but even a fleet of electric cars in an on-demand system doesn't solve all problems. As a study by the Institute for European Environmental Policy shows, driving leads to physical inactivity–one of the leading causes of preventable death worldwide. Integrating electric bikes such as the Persuasive Electric Vehicle for city bike lanes (PEV) is a starting point for healthy mobility. The real challenge, though, is changing city dwellers' behavior to choose a healthy and sustainable mobility solution like a PEV. A behavior-changing support system like a pervasive application will persuade users to make better choices.

155. Robotic Facade / Personalized Sunlight

Harrison Hall, Kent Larson and Shaun David Salzberg

The robotic façade is conceived as a mass-customizable module that combines solar control, heating, cooling, ventilation, and other functions to serve an urban apartment. It attaches to the building "chassis" with standardized power, data, and mechanical attachments to simplify field installation and dramatically increase energy performance. The design makes use of an articulating mirror to direct shafts of sunlight to precise points in the apartment interior. Tiny, low-cost, easily installed wireless sensors and activity recognition algorithms allow occupants to use a mobile phone interface to map activities of daily living to personalized sunlight positions. We are also developing strategies to control LED luminaires to turn off, dim, or tune the lighting to more energy-efficient spectra in response to the location, activities, and paths of the occupants.

Alumni Contributor: Ronan Patrick Lonergan

156. SeedPod: Interactive Farming Module

Kent Larson, Jennifer Broutin and Topper Carew with Caleb Harper, Kirsten Lim and Catherine Winfield

We are developing an interactive farming module that serves as a platform for closing the loop between people and food. The structure will function as a scalable, modular system augmented by technology such as monitoring sensors, robotic components, and energy-capture devices to facilitate ease and a deeper understanding of the process through which aeroponic vegetables are grown. A database and monitoring network is set up to determine growing needs and profiles of plant species to provide real-time feedback information in assisting with plant care. A prototype is being developed for deployment within the Boston public school system. Curricula will be proposed to aid students in monitoring the system through constructivist learning principles, aiding the implementation of STEM research in schools. By bringing farming to urban areas, we will short-circuit the opacity of large-scale agriculture and create a feedback cycle for healthier, sustainable living.

157. Shortest Path Tree

Kent Larson and Brandon Phillip Martin-Anderson

NEW LISTING

Shortest Path Tree is an experimental way to interact with an algorithmic multimodal trip planner. It emphasizes how the shape of the city interacts with the planning process embedded in every mobility decision.

158. Smart Customization of Men's Dress Shirts: A Study on Environmental Impact

Ryan C. C. Chin, Daniel Smithwick and Kent Larson

Sanders Consulting's 2005 ground-breaking research, "Why Mass Customization is the Ultimate Lean Manufacturing System" showed that the best standard mass-production practices when framed from the point of view of the entire product lifecycle–from raw material production to point of purchase–was actually very inefficient and indeed wasteful in terms of energy, material use, and time. Our research examines the environmental impacts when applying mass customization methodologies to men's custom dress shirts. This study traces the production, distribution, sale, and customer-use of the product, in order to discover key areas of waste and opportunities for improvement. Our comparative study examines not only the energy and carbon emissions due production and distribution, but also customer acquisition and use, by using RFID tag technology to track shirt utilization of over 20 subjects over a three-month period.

159. Smart DC MicroGrid

Kent Larson and Christophe Yoh Charles Meyers

NEW LISTING

Given the increasing development of renewable energy, its integration into the electric distribution grid needs to be addressed. In addition, the majority of household appliances operate on DC. The aim of this project is to develop a microgrid capable of addressing these issues, while drawing on a smart control system.

160. smartCharge

Praveen Subramani, Sean Cockey, Guangyan Gao, Jean Martin and Kent Larson

NEW LISTING

Have you ever used a vehicle sharing program like ZipCar or Boston's Hubway bike sharing? With the next generation of lightweight electric vehicles being deployed in vehicle sharing systems across the world, there is a growing need for smarter charging infrastructure. smartCharge is the next generation of intelligent, networked charging infrastructure for electric vehicles in cities. Specifically optimized for electric vehicle sharing systems, the smartCharge platform integrates secure locking, high current vehicle charging (up to 36A), and data transfer into a single connector. Furthermore, a concentric connector design allows users to insert the plug from any angle, allowing them to quickly lock and charge the rented vehicle without wasting valuable time and space with separate docking and charging systems. The system connects vehicles to a smart charging post that integrates ambient LED lighting to provide feedback to users on the current state of charge of the vehicle, its availability state, and maintenance needs. The connection system is universally designed to function with electric bicycles, scooters, cars, and other lightweight electric vehicles.

161. Wheel Robots

William Lark, Jr., Nicholas Pennycooke, Ryan C.C. Chin and Kent Larson

The mechanical components that make driving a vehicle possible (acceleration, braking, steering, springing) are located inside the space of the wheel, forming independent wheel robots and freeing the vehicular space of these components. Connected to the chassis are simple mechanical, power, and data connections, allowing for the wheel robots to plug in to a vehicle simply and quickly. A CPU in the vehicle provides the input necessary for driving according to the vehicle's dimensions or loading condition. The design of the wheel robots provides optimal contact patch placement, lower unsprung and rotational mass, omnidirectional steering, great space savings, and modularity, as the wheel robots can function appropriately on vehicles of different dimensions and weight. (Continuing the vision of William J. Mitchell.)

Alumni Contributors: Patrik Kunzler, Philip Liang and William J. Mitchell

162. WorkLife

Jarmo Suominen and Kent Larson

The nature of work is rapidly changing, but designers have a poor understanding of how places of work affect interaction, creativity, and productivity. We are using mobile phones that ask context-triggered questions and sensors in workplaces to collect information about how spaces are used and how space influences feelings such as productivity and creativity. A pilot study took place at the Steelcase headquarters in 2007, and in the offices of EGO, Inc. in Helsinki, Finland 2009. (A House_n Research Consortium project funded by TEKES.)

Alumni Contributor: Kenneth Cheung

Henry Lieberman—Software Agents

How software can act as an assistant to the user rather than a tool, by learning from interaction and by proactively anticipating the user's needs.

163. Common-Sense Reasoning for Interactive Applications

Henry Lieberman

A long-standing dream of artificial intelligence has been to put common-sense knowledge into computers–enabling machines to reason about everyday life. Some projects, such as Cyc, have begun to amass large collections of such knowledge. However, it is widely assumed that the use of common sense in interactive applications will remain impractical for years, until these collections can be considered sufficiently complete, and common-sense reasoning sufficiently robust. Recently we have had some success in applying common-sense knowledge in a number of intelligent interface agents, despite the admittedly spotty coverage and unreliable inference of today's common-sense knowledge systems.

Alumni Contributors: Xinyu H. Liu and Push Singh

164. CommonConsensus: A Game for Collecting Commonsense Goals

Henry Lieberman and Dustin Smith

We have developed, Common Consensus: a fun, self-sustaining web-based game, that both collects and validates Commonsense knowledge about everyday goals. Goals are a key element of commonsense knowledge; in many of our inferface agents, we need to recognize goals from user actions (plan recognition), and generate sequences of actions that implement goals (planning). We also often need to answer more general questions about the situations in which

goals occur, such as when and where a particular goal might be likely, or how long it is likely to take to achieve.

Alumni Contributor: Push Singh

165. E-Commerce When Things Go Wrong

Henry Lieberman

One of the biggest challenges for the digital economy is what to do when things go wrong. Orders get misplaced, numbers mistyped, requests misunderstood: then what? Consumers are frustrated by long waits on hold, misplaced receipts, and delays to problem resolution; companies are frustrated by the cost of high-quality customer service. Online companies want customers' trust, and how a company handles problems directly impacts that. We explore how software agents and other technologies can help with this issue. Borrowing ideas from software debugging, we can have agents help to automate record-keeping and retrieval, track dependencies, and provide visualization of processes. Diagnostic problem-solving can generate hypotheses about causes of errors, and seek information that allows hypotheses to be tested. Agents act on behalf of both the consumer and the vendor to resolve problems more quickly and at lower cost.

166. Goal-Oriented Interfaces for Consumer Electronics

Henry Lieberman and Pei-Yu Chi

Consumer electronics devices are becoming more complicated, intimidating users. These devices do not know anything about everyday life or human goals, and they show irrelevant menus and options. Using common-sense reasoning, we are building a system, Roadie, with knowledge about the user's intentions; this knowledge will help the device to display relevant information to reach the user's goal. For example, an amplifier should suggest a play option when a new instrument is connected, or a DVD player suggest a sound configuration based on the movie it is playing. This will lead to more human-like interactions with these devices. We have constructed a Roadie interface to real consumer electronics devices: a television, set top box, and smart phone. The devices communicate over Wi-Fi, and use the UPnP protocols.

Alumni Contributor: Jose H. Espinosa

167. Goal-Oriented Interfaces for Mobile Phones

Henry Lieberman, Karthik Dinakar, Christopher Fry, Dustin Arthur Smith, Hal Abelson and Venky Raju

Contemporary mobile phones provide a vast array of capabilities in so-called "apps," but currently each app lives in its own little world, with its own interface. Apps are usually unable to communicate with each other and unable to cooperate to meet users' needs. This project intends to enable end-users to "program" their phones using natural language and speech recognition to perform complex tasks. A user, for example, could say: "Send the song I play most often to Bill." The phone should realize that an MP3 player holds songs, and that the MP3 app has a function to order songs by play frequency. It should know how to send a file to another user, and how to look up the user's contact information. We use state-of-the art natural language understanding, commonsense reasoning, and a partial-order planner.

168. Graphical Interfaces for Software Visualization and Debugging

Henry Lieberman

This project explores how modern graphical interface techniques and explicit support for the user's problem-solving activities can make more productive interfaces for debugging, which accounts for half the cost of software development. Animated representations of code, a reversible control structure, and instant connections between code and graphical output are some of the techniques used.

169. Human Goal Network

Henry Lieberman and Dustin Smith

What motivates people? What changes do people want in the world? We approach questions of this kind by mining goals and plans from text-based websites: wikiHow, eHow, 43things, to-do lists, and commonsense knowledge bases. 43things tells us about people's long term ambitions. How-to instructions and to-do lists tell us about everyday activities. We've analyzed the corpus to find out which goals are most popular, controversial, and concealed. The resulting goal network can be used for plan recognition, natural language understanding, and building intelligent interfaces that understand why they are being used. Come by and learn about how you can use this knowledge about actions/goals, their properties (cost, duration, location) and their relations in your own applications.

170. Learning Common Sense in a Second Language

Henry Lieberman, Ned Burns and Li Bian

It's well known that living in a foreign country dramatically improves the effectiveness of learning a second language over classroom study alone. This is likely because people make associations with the foreign language as they see and participate in everyday life activities. We are designing language-teaching sequences for a sensor-equipped residence that can detect user interaction with household objects. We use our common-sense knowledge base and reasoning tools to construct teaching sequences, wholly in the target language, of sentences and question-answering interactions that gradually improve the learner's language competence. For example, the first time the user sits in a chair, the system responds with the foreign-language word for "chair," and later with statements and questions such as, "You sit in the chair" (complete sentence), "You sat in the chair" (tenses), "What is the chair made of?" (question, materials), or "Why are you sitting in the chair?" (goals, plans).

171. Multi-Lingual ConceptNet

Hyemin Chung, Jaewoo Chung, Wonsik Kim, Sung Hyon Myaeng and Walter Bender

A ConceptNet in English is already established and working well. We are now attempting to expand it to other languages and cultures. This project is an extended ConceptNet with Korean common sense, which is fundamentally different from English. Through this project, we can learn how to expand the ConceptNet into other languages and how to connect them. By connecting English and Korean ConceptNets, we are hoping not only to see cultural or linguistic differences, but also to solve problems such as the ambiguity of multivocal words, which were difficult to solve with only one ConceptNet.

172. Multilingual Common Sense

Aparecido Fabiano Pinatti de Carvalho, Jesus Savage Carmona, Marie Tsutsumi, Junia Anacleto, Henry Lieberman, Jason Alonso, Kenneth Arnold, Robert Speer, Vania Paula de Almeida and Veronica Arreola Rios

This project aims to collect and reason over common-sense knowledge in languages other than English. We have collected large bodies of common-sense knowledge in Portuguese and Korean, and we are expanding to other languages such as Spanish, Dutch, and Italian. We can use techniques based on AnalogySpace to discover correlations between languages, enabling our knowledge bases in different languages to learn from each other.

Alumni Contributors: Hyemin Chung, Jose H. Espinosa, Wonsik Kim and Yu-Te Shen

173. Navigating in Very Large Display Spaces

Henry Lieberman

How would you browse a VERY large display space, such as a street map of the entire world? The traditional solution is zoom and pan, but these operations have drawbacks that have gone unchallenged for decades. Shifting attention loses the wider context, leading to that "lost in hyperspace" feeling. We are exploring alternative solutions, such as a new technique that allows zooming and panning in multiple translucent layers.

174. Open Interpreter

Henry Lieberman and Dustin Arthur Smith

Language interpretation requires going beyond the words to derive what the speaker meant–cooperatively making 'leaps of faith' and putting forth assumptions that can later be revised or redacted. Current natural language interfaces are opaque; when interpretation goes wrong–which it inevitably does–the human is left without recourse. The Open Interpreter project brings the assumptions involved with interpreting English event descriptions into the user interface, so people can participate in teaching the computer to derive the same common-sense assumptions that they expected. We show the immediate applications for an intelligent calendaring application.

175. ProcedureSpace: Managing Informality by Example

Henry Lieberman and Kenneth C. Arnold

Computers usually require us to be precise about what we want them to do and how, but humans find it hard to be so formal. If we gave computers formal examples of our informal instructions, maybe they could learn to relate ordinary users' natural instructions with the specifications, code, and tests with which they are comfortable. Zones and ProcedureSpace are examples of this. Zones is a code search interface that connects code with comments about its purpose. Completed searches become annotations, so the system learns by example. The backend, ProcedureSpace, finds code for a purpose comment (or vice versa) by relating words and phrases to code characteristics and natural language background knowledge. Users of the system were able describe what they wanted in their own words, and often found that the system gave them helpful code.

176. Programming in Natural Language

Henry Lieberman and Moin Ahmad

We want to build programming systems that can converse with their users to build computer programs. Such systems will enable users without programming expertise to write programs using natural language. The text-based, virtual-world environments called the MOO (multi-user, object-oriented Dungeons and Dragons) allow their users to build objects and give them simple, interactive, text-based behaviors. These behaviors allow other participants in the environment to interact with those objects by invoking actions and receiving text messages. Through our natural-language dialogue system, the beginning programmer will be able to describe objects and the messages in MOO environments.

177. Raconteur: From Chat to Stories

Henry Lieberman and Pei-Yu Chi

Raconteur is a story-editing system for conversational storytelling that provides intelligent assistance in illustrating a story with photos and videos from an annotated media library. It performs natural language processing on a text chat between two or more participants, and recommends appropriate items from a personal media library to illustrate a story. A large common-sense knowledge base and a novel common-sense inference technique are used to find relevant media materials to match the story intent in a way that goes beyond keyword matching or word co-occurrence based techniques. Common-sense inference can identify larger-scale story patterns such as expectation violation or conflict and resolution, and helps a storyteller to chat and brainstorm his personal stories with a friend.

178. Relational Analogies in Semantic Networks

Henry Lieberman and Jayant Krishnamurthy

Analogy is a powerful comparison mechanism, commonly thought to be central to human problem solving. Analogies like "an atom is like the solar system" enable people to effectively transfer knowledge to new domains. Can we enable computers to do similar comparisons? Prior work on analogy (structure mapping) provides guidance about the nature of analogies, but implementations of these theories are inefficient and brittle. We are working on a new analogy mechanism that uses instance learning to make robust, efficient comparisons.

179. Ruminati: Tackling Cyberbullying with Computational Empathy

Karthik Dinakar, Henry Lieberman, and Birago Jones

The scourge of cyberbullying has assumed worrisome proportions with an ever-increasing number of adolescents admitting to having dealt with it either as a victim or bystander. Anonymity and the lack of meaningful supervision in the electronic medium are two factors that have exacerbated this social menace. This project explores computational methods from natural language processing and reflective user interfaces to alleviate this problem.

180. Storied Navigation

Henry Lieberman

Today, people can tell stories by composing, manipulating, and sequencing individual media artifacts using digital technologies. However, these tools offer little help in developing a story's plot. Specifically, when a user tries to construct her story based on a collection of individual media elements (videos, audio samples), current technological tools do not provide helpful information about the possible narratives that these pieces can form. Storied Navigation is a novel approach to this problem; media sequences are tagged with free-text annotations and stored as a collection. To tell a story, the user inputs a free-text sentence and the system suggests possible segments for a storied succession. This process iterates progressively, helping the user to explore the domain of possible stories. The system achieves the association between the input and the segments' annotations using reasoning techniques that exploit the WordNet semantic network and common-sense reasoning technology.

Alumni Contributors: Barbara Barry, Glorianna Davenport and edshen

181. Time Out: Reflective User Interface for Social Networks

Birago Jones, Henry Lieberman and Karthik Dinakar

Time Out is a experimental user interface system for addressing cyberbullying on social networks. A Reflective User Interface (RUI) is a novel concept to help users consider the possible consequences of their online behavior, and assist in intervention or mitigation of potentially negative/harmful actions.

Andy Lippman—Viral Spaces

How to make scalable networks that merge the distant with the physically nearby.

182. Air Mobs

Andy Lippman, Henry Holtzman and Eyal Toledano

Airmobs is a community-based P2P cross-operator WiFi tethering market. It provides network connectivity when one device has no available Internet connection or roaming costs are too high, and another device has excellent network connectivity and a full battery. Airmobs barters air time between different mobile phone users using WiFi tethering to locate and establish an internet link though another device that has a good 3G connection. The member that provides the link will gain airtime credit that can be used when he is notconnected. Airmobs creates incentive via a secondary market–a user will be willing to share his data connection since he will get data in return. The synergetic value emerges when different users on different mobile operators provide network access to each other, compensating for each operator's out-of-coverage areas.

183. Barter: A Market-Incented Wisdom Exchange

Dawei Shen, Marshall Van Alstyne and Andrew Lippman

Creative and productive information interchange in organizations is often stymied by a perverse incentive setting among the members. We transform that competition into a positive exchange by using market principles. Specifically, we apply innovative market mechanisms to construct incentives while still encouraging pro-social behaviors. Barter includes means to enhance knowledge sharing, innovation creation, and productivity. It is being tested at MIT and in three sponsor companies and is becoming available as a readily installable package. We will measure the results and test the effectiveness of an information market in addressing organizational challenges. We are learning that transactions in rich markets can become an organizing principle among people potentially as strong as social networks.

184. Brin.gy: What Brings Us Together

Henry Holtzman, Andy Lippman and Polychronis Ypodimatopoulos

We allow people to form dynamic groups focused on topics that emerge serendipitously during everyday life. They can be long-lived or flower only for a short time. Examples include people interested in buying the same product, those with similar expertise, those in the same location, or any collection of such attributes. We call this the Human Discovery Protocol (HDP). Similar to how computers follow well-established protocols like DNS in order to find other computers that carry desired information, HDP presents an open protocol for people to announce bits of information about themselves, and have them aggregated and returned back in the form of a group of people that match against the user's specified criteria. We experiment with a web-based implementation (brin.gy) that allows users to join and communicate with groups of people based on their location, profile information, and items they may want to buy or sell.

185. CoCam

Andy Lippman, Henry Holtzman, Eyal Toledano, Dan Sawada

NEW LISTING

Collaborating and media creation are difficult tasks, both for people and for network architectures. CoCam is a self-organizing network for real-time camera image collaboration. Like all camera apps, just point and shoot; CoCam then automatically joins other media creators into a network of collaborators. Network discovery, creation, grouping, joining, and leaving is done automatically in the background, letting users focus on participation in an event. We use local P2P middleware and a 3G negotiation service to create these networks for real-time media sharing. CoCam also provides multiple views that make the media experience more exciting–such as appearing to be in multiple places at the same time. The media is immediately distributed and replicated in multiple peers, thus if a camera phone is confiscated other users have copies of the images.

186. Compound Interest

Andy Lippman, Julia Shuhong Ma and Sherwin Wu

NEW LISTING

How are people's interests related? By exploring people's interests from LinkedIn profiles, we have created an interest graph to understand these relationships. The graph nodes are interests (hiking, painting, design), color-coded by category. Links between nodes appear when interests co-occur in multiple profiles. By looking at the graph, we can see which interests are more commonly shared among people, and whether these interests are in the same category (that is, similar to each other). This allows us to form hypotheses about how and why certain interests co-occur more often than others, and measure the diversity of a person's interests.

187. Electric Price Tags

Andy Lippman, Matthew Blackshaw and Rick Borovoy

Electric Price Tags are a realization of a mobile system that is linked to technology in physical space. The underlying theme is that being mobile can mean far more than focusing on a portable device—it can be the use of that device to unlock data and technology embedded in the environment. In its current version, users can reconfigure the price tags on a store shelf to display a desired metric (e.g., price, unit price, or calories). While this information is present on the boxes of the items for sale, comparisons would require individual analysis of each box. The visualization provided by Electric Price Tags allows users to view and filter information in physical space in ways that was previously possible only online.

188. Geo.gy: Location shortener

Andy Lippman and Polychronis Ypodimatopoulos

Were you ever in the middle of a conversation and needed to share your location with the other party? Geo.gy is a location shortener service. It allows you to easily share your location with your peers by encoding it in a short URL which we call a "geolink". It is platform-independent, based on HTML5, so you can use any device with a modern browser to generate a geolink, simply by visiting the project's page. There are no user accounts so geolinks remain anonymous. You can use Geo.gy to add location context to a post, SMS, anything you want decorated with location context.

189. Line of Sound

Grace Rusi Woo, Rick Borovoy and Andy Lippman

We show how data can be used to deliver sound information only in the direction in which one looks. The demonstration is done using two 55-inch screens which are transmitting both human and machine relevant information. Each screen is used to show a video which flashes a single bit indicator which transmits to a camera mounted on headphones. This is used to distinguish between the two screens, and to correlate an audio track to the video track.

190. Meld

Hiroshi Ishii, Andy Lippman, Matthew Blackshaw, Anthony DeVincenzi and David Lakatos

Meld provides a new perspective on your social life. By presenting your social graph as a moving picture, Meld breaks free from the text-centric interfaces of today's social networks, offering a fresh, holistic perspective. Unseen trends, before lost in mountains of text, can be better understood, providing an organic and evolving view of your relationships. Meld is a semi-finalist in the MIT 100K Entrepreneurship Competition.

191. NewsFlash

Andy Lippman, Grace Rusi Woo and Travis Rich

NewsFlash is a social way to experience the global and local range of current events. People see a tapestry of newspaper front-pages. The headlines and main photos tell part of the story, NewsFlash tells you the rest. People point their phones at a headline or picture of interest to bring up a feed of the article text from that given paper. The data emanates from the screen and and is captured by a cell phone camera–any number of people can see it at once and discuss the panoply of ongoing events. NewsFlash creates a local space that is simultaneously interactive and provocative. We hope it gets people talking.

192. Peddl

Andy Lippman, Hiroshi Ishii, Matthew Blackshaw, Anthony DeVincenzi and David Lakatos

NEW LISTING

Peddl creates a localized, perfect market. All offers are broadcasts, allowing users to spot trends, bargains, and opportunities. With GPS- and Internet-enabled mobile devices in almost every pocket, we see an opportunity for a new type of marketplace which takes into account your physical location, availability, and open negotiation. Like other real-time activities, we are exploring transactions as an organizing principle among people that, like Barter, may be strong, rich, and long-lived.

193. Point & Shoot Data

Andy Lippman and Travis Rich

NEW LISTING

Point & Shoot Data explores the use of visible light as a wireless communication medium for mobile devices. A snap-on case allows users to send messages to other mobile devices based on directionality and proximity. No email address, phone number, or account login is needed, just point and shoot your messages! The project enables infrastructure-free, scalable, proximity-based communication between two mobile devices.

Alumni Contributors: Samuel Luescher and Shaun David Salzberg

194. Reach

Andy Lippman, Boris G Kizelshteyn and Rick Borovoy

Reach merges inherently local communications with user requests or offers of services. It is built atop data from services users already use, like Facebook and Google Latitude. Reach is intended to demonstrate a flexible, attractive mobile interface that allows one to discover "interesting"

aspects of the environment and to call upon services as needed. These can range from a broadcast offer to serve as a triage medic, to a way to share a cab or get help for a technical service problem like plugging into a video projector.

195. Recompose

Hiroshi Ishii, Matthew Blackshaw, Anthony DeVincenzi and David Lakatos

Human beings have long shaped the physical environment to reflect designs of form and function. As an instrument of control, the human hand remains the most fundamental interface for affecting the material world. In the wake of the digital revolution, this is changing, bringing us to reexamine tangible interfaces. What if we could now dynamically reshape, redesign, and restructure our environment using the functional nature of digital tools? To address this, we present Recompose, a framework allowing direct and gestural manipulation of our physical environment. Recompose complements the highly precise, yet concentrated affordance of direct manipulation with a set of gestures, allowing functional manipulation of an actuated surface.

196. Social Transactions/Open Transactions

Andy Lippman, Kwan Lee, Dawei Shen, Eric Shyu and Phumpong Watanaprakornkul

Social Transactions is an application that allows communities of consumers to collaboratively sense the market from mobile devices, enabling more informed financial decisions in a geo-local and timely context. The mobile application not only allows users to perform transactions, but also to inform, share, and purchase in groups at desired times. It could, for example, help people connect opportunistically in a local area to make group purchases, pick up an item for a friend, or perform reverse auctions. Our framework is an Open Transaction Network that enables applications from restaurant menu recommendations to electronics purchases. We tested this with MIT's TechCASH payment system to investigate whether shared social transactions could provide just-in-time influences to change behaviors.

197. T(ether)

Hiroshi Ishii, Andy Lippman, Matthew Blackshaw and David Lakatos

T(ether) is a novel spatially aware display that supports intuitive interaction with volumetric data. The display acts as a window affording users a perspective view of three- dimensional data through tracking of head position and orientation. T(ether) creates a 1:1 mapping between real and virtual coordinate space allowing immersive exploration of the joint domain. Our system creates a shared workspace in which co-located or remote users can collaborate in both the real and virtual worlds. The system allows input through capacitive touch on the display and a motion-tracked glove. When placed behind the display, the user’s hand extends into the virtual world, enabling the user to interact with objects directly.

198. T+1

Dawei Shen, Rick Borovoy and Andrew Lippman

T+1 is an application that creates an iterative structure to help groups organize their interests and schedules. Users of T+1 receive instructions and send their personal information through mobile devices at discretized time steps, orchestrated by a unique, adaptive scheduling engine. At each time-step t, T+1 takes as inputs several relevant factors of human interactions, such as participants' interests, opinions, locations, and partner matching schedules. It then computes and optimizes the structure and format of a group interactions for the next interval. T+1 facilitates consensus formation, better group dynamics, and more engaging user experiences by using a clearly visible and comprehensible process. We are planning to deploy the platform in both academic and political discussion settings, analyze how user opinions and interests evolve in time to understand its efficacy.

199. The Glass Infrastructure

Henry Holtzman, Andy Lippman, Matthew Blackshaw, Jon Ferguson, Catherine Havasi, Julia Ma, Daniel Schultz and Polychronis Ypodimatopoulos

This project builds a social, place-based information window into the Media Lab using 30 touch-sensitive screens strategically placed throughout the physical complex and at sponsor sites. The idea is get people to talk among themselves about the work that they jointly explore in a public place. We present Lab projects as dynamically connected sets of "charms" that visitors can save, trade, and explore. The GI demonstrates a framework for an open, integrated IT system and shows new uses for it.

Alumni Contributors: Rick Borovoy, Greg Elliott and Boris Grigory Kizelshteyn

200. VR Codes

Andy Lippman and Grace Woo

VR Codes are dynamic data invisibly hidden in television and graphic displays. They allow the display to present simultaneously visual information in an unimpeded way, and real-time data to a camera. Our intention is to make social displays that many can use at once; using VR codes, many can draw data from a display and control its use on a mobile device. We think of VR Codes as analogous to QR codes for video, and envision a future where every display in the environment contains latent information embedded in VR codes.

Tod Machover—Opera of the Future

How musical composition, performance, and instrumentation can lead to innovative forms of expression, learning, and health.

201. A Toronto Symphony: Massive Musical Collaboration

NEW LISTING

Tod Machover and Peter Alexander Torpey

The results of existing crowd-sourced and interactive music are limited so far, with the public being only a small part of a final musical result, and often disconnected from the artist leading the project. We believe that a new "musical ecology" is needed for true creative collaboration between experts and amateurs that benefits both. For this purpose, we are creating a new work for symphony orchestra in collaboration with the entire city of Toronto. Called "A Toronto Symphony," the work–commissioned by the Toronto Symphony Orchestra–will be premiered in March 2013. We are designing the necessary infrastructure, creative tools based on Hyperscore, social media framework, and real-world community-building activities to bring together an unprecedented number of people from diverse ages, experiences, and musical backgrounds to create this new work. We also will establish a model for creating complex creative collaborations between experts and everyone else.

202. Advanced Audio Systems for Live Performance

Tod Machover and Ben Bloomberg

This project explores the contribution of advanced audio systems to live performance, their design and construction, and their integration into the theatrical design process. We look specifically at innovative input and control systems for shaping the analysis and processing of live performance; and at large-scale output systems which provide a meaningful virtual abstraction to DSP in order to create flexible audio systems that can both adapt to many environments and achieve a consistent and precise sound field for large audiences.

203. Coda

NEW LISTING

Eyal Shahar and Stephen Bresnick

Coda is a collaborative musical-knowledge database in which articles are accessed by selecting graphic entities in a musical score. Coda is meant to serve as the center for a community of learners sharing music-theory knowledge and musical ideas through musical pieces with personal meaning.

204. CogNotes: Cognitive Assessment in Social Media-Enabled Creativity Tools

Tod Machover and Adam Boulanger

With CogNotes, new music composition tools become platforms for cognitive assessment. CogNotes users engage their memory as they emerge as composers and participants in their own health process. Together with partners the Lincoln Park Performing Arts School and the Yamaha Corporation, a group of seniors are undertaking an extensive multi-month music composition workshop built around Tod Machover's Hyperscore program. The program is outfitted with cognitive measures sensitive to the earliest transition to Alzheimer's Disease, validated as part of post-doc Adam Boulanger's research with Harvard Medical School and the Alzheimer's Association. Disease assessment can be part of your everyday, creative, and rewarding life. You can be the manager of your own health information as part of the activities you love.

205. Dance, Emotion, and Expression

Tod Machover and Janice Wang

Dance is an expressive activity that combines music and movement. We are interested in both encouraging people to dance, and in measuring the emotional experience of musical expression through movement. The Dance Remixer is a program that transforms any piece of music into something that people can dance to. The program remixes music to add customizable rhythmic elements–for instance, those typical to Latin dance music. The Dance Remixer is a first step toward personalizing how people interact with music, by giving the user the ability to modify its function and emotional content. We are also interested in quantitatively measuring the emotional experience of dancing. What makes dancing enjoyable? How is our enjoyment of music reflected in dance? Specifically, we examine the psychological factors behind Argentine Tango, an improvisational dance that prioritizes the interpretation of music.

206. Death and the Powers: Redefining Opera

Tod Machover, Ben Bloomberg, Peter Torpey, Elena Jessop, Bob Hsiung, Michael Miller, Akito van Troyer, and Eyal Shahar

"Death and the Powers" is a groundbreaking opera that brings a variety of technological, conceptual, and aesthetic innovations to the theatrical world. Created by Tod Machover (composer), Diane Paulus (director), and Alex McDowell (production designer), the opera uses the

techniques of tomorrow to address age-old human concerns of life and legacy. The unique performance environment, including autonomous robots, expressive scenery, new Hyperinstruments, and human actors, blurs the line between animate and inanimate. The opera premiered in Monte-Carlo in fall 2010, with additional performances in Boston and Chicago in 2011 and continuing engagements worldwide.

207. Disembodied Performance

Tod Machover, Peter Torpey and Elena Jessop

Early in the opera "Death and the Powers," the main character Simon Powers is subsumed into a technological environment of his own creation. The set comes alive through robotic, visual, and sonic elements that allow the actor to extend his range and influence across the stage in unique and dynamic ways. This environment must assume the behavior and expression of the absent Simon; to distill the essence of this character, we recover performance parameters in real time from physiological sensors, voice, and vision systems. Gesture and performance parameters are then mapped to a visual language that allows the off-stage actor to express emotion and interact with others on stage. To accomplish this, we developed a suite of innovative analysis, mapping, and rendering software systems. Our approach takes a new direction in augmented performance, employing a non-representational abstraction of a human presence that fully translates a character into an environment.

208. DrumTop

Tod Machover and Akito Oshiro van Troyer

This project aims to transform everyday objects into percussive musical instruments, encouraging people to rediscover their surroundings through musical interactions with the objects around them. DrumTop is a drum machine made up of eight transducers. Placing objects on top of the transducers triggers a "hit," causing sounds to come out from the objects themselves. In addition, users can program drum patterns by pushing on a transducer, and the weight of an object can be measured to control the strength of a “hit.”

209. Gestural Media Framework

Tod Machover and Elena Jessop

We are all equipped with two extremely expressive instruments for performance: the body and the voice. By using computer systems to sense and analyze human movement and voices, artists can take advantage of technology to augment the body's communicative powers. However, the sophistication, emotional content, and variety of expression possible through the original physical channels is often not captured by or addressed in the technologies used for analyzing them, and thus cannot be transferred from body to digital media. To address these issues, we are developing systems that use machine learning to map continuous input data, whether of gesture or voice or biological/physical states, to a space of expressive, qualitative parameters. We are also developing a new framework for expressive performance augmentation, allowing users to easily create clear, intuitive, and comprehensible mappings by using high-level qualitative movement descriptions, rather than low-level descriptions of sensor data streams.

210. Hyperinstruments

Tod Machover

The Hyperinstrument project creates expanded musical instruments and uses technology to give extra power and finesse to virtuosic performers. They were designed to augment a wide range of traditional musical instruments and have been used by some of the world's foremost performers (Yo-Yo Ma, the Los Angeles Philharmonic, Peter Gabriel, and Penn & Teller). Research focuses on designing computer systems that measure and interpret human expression and feeling, exploring appropriate modalities and content of interactive art and entertainment environments, and building sophisticated interactive musical instruments for non-professional musicians, students, music lovers, and the general public. Recent projects involve both new hyperinstruments for children and amateurs, and high-end hyperinstruments capable of expanding and transforming a symphony orchestra or an entire opera stage.

Alumni Contributors: Roberto M. Aimi, Mary Farbood, Ed Hammond, Tristan Jehan, Margaret Orth, Dan Overholt, Egon Pasztor, Joshua Strickon, Gili Weinberg and Diana Young

211. Hyperscore

Tod Machover

Hyperscore is an application to introduce children and non-musicians to musical composition and creativity in an intuitive and dynamic way. The "narrative" of a composition is expressed as a line-gesture, and the texture and shape of this line are analyzed to derive a pattern of tension-release, simplicity-complexity, and variable harmonization. The child creates or selects individual musical fragments in the form of chords or melodic motives, and layers them onto the narrative-line with expressive brushstokes. The Hyperscore system automatically realizes a full composition from a graphical representation, allowing individuals with no musical training to create professional pieces. Currently, Hyperscore uses a mouse-based interface; the final version will support freehand drawing, and integration with the Music Shapers and Beatbugs to provide a rich array of tactile tools for manipulation of the graphical score.

Alumni Contributors: Mary Farbood, Ed Hammond, Tristan Jehan, Margaret Orth, Dan Overholt, Egon Pasztor, Joshua Strickon, Gili Weinberg and Diana Young

212. Media Scores

Tod Machover and Peter Torpey

Media Scores extends the concept of a musical score to other modalities to facilitate the process of authoring and performing multimedia compositions, providing a medium through which to realize a modern-day Gesamtkunstwerk. Through research into the representation and the encoding of expressive intent, systems for composing with media scores are being developed. Using such a tool, the composer will be able to shape an artistic work that may be performed through human and technological means in a variety of media and modalities. Media scores offer the potential for authoring content considering live performance data and the potential for audience participation and interaction. This paradigm bridges the extremes of the continuum from composition to performance, allowing for improvisatory compositional acts at performance time. The media score also provides a common point of reference in collaborative productions as well as the infrastructure for real-time control of technologies used during live performance.

213. New Experiences in Music and Food

NEW LISTING

Tod Machover and Janice Wang

Food offers a rich multi-modal experience that can deeply affect emotion and memory. We're interested in exploring the artistic and expressive potential of food beyond mere nourishment, as a means of creating memorable experiences that involve multiple senses. For instance, music can change our eating experience by altering our emotions during the meal, or by evoking a specific time and place. In other words, we can use music to set expectations, which can be met or violated for expressive effect. An example of complementary pairing is British chef Heston Blumenthal's Sound of the Sea dish served with an iPod. In addition, food and music are both art forms that are heavily loaded with personal meaning. By utilizing the power of these mediums, we can create highly individualized sensory experiences.

214. Personal Opera

Tod Machover and Peter Torpey

Personal Opera is a radically innovative creative environment that enables anyone to create musical masterpieces sharing one's deepest thoughts, feelings, and memories. Based on our design of, and experience with, such projects as Hyperscore and the Brain Opera, we are developing a totally new environment to allow the incorporation of personal stories, images, and both original and well-loved music and sounds. Personal Opera builds on our guiding principle that active music creation yields far more powerful benefits than passive listening. Using music as the through-line for assembling and conveying our own individual legacies, Personal Opera represents a new form of expressive archiving; easy to use and powerful to experience. In partnership with the Royal Opera House in London, we have begun conducting Personal Opera workshops specifically targeting seniors to help them tell their own meaningful stories through music, text, visuals, and acting.

215. Remote Theatrical Immersion: Extending "Sleep No More"

NEW LISTING

Tod Machover, Punchdrunk, Akito Van Troyer, Ben Bloomberg, Gershon Dublon, Jason Haas, Elena Jessop, Eyal Shahar, Jie Qi, Nicholas Joliat, and Peter Torpey

We are collaborating with London-based theater group Punchdrunk to create an online platform connected to their NYC show, Sleep No More. In the live show, masked audience members explore and interact with a rich environment, discovering their own narrative pathways. We are developing an online companion world to this real-life experience, through which online participants partner with live audience members to explore the interactive, immersive show together. Pushing the current capabilities of web standards and wireless communications technologies, the system will deliver personalized multimedia content allowing each online participant to have a unique experience co-created in real time by his own actions and those of his onsite partner. This project explores original ways of fostering meaningful relationships between online and onsite audience members, enhancing the experiences of both through the affordances that exist only at the intersection of the real and the virtual worlds.

216. SoundStrand

Tod Machover and Eyal Shahar

SoundStrand is a music composition toy. It comprises a set of building blocks, each containing a musical motif. The blocks can be connected to each other to create a musical theme. They can also be manipulated with three degrees of freedom: elongation changes the rhythmic distribution of the notes; bending changes the direction of the melody; and twisting changes the harmonic context.

217. Vocal Vibrations: Expressive Performance for Body-Mind Wellbeing

Tod Machover and Elena Jessop

The voice and the body are instruments that everyone possesses–they are incredibly individual, infinitely expressive, and intimately linked to one's own physical form. As such, they can affect us on both emotional and anatomical levels. Building on our recent work on capturing operatic performances for Death and the Powers, we are now creating the next generation of tools for analyzing and enhancing expressive vocal and physical performance. Using sophisticated voice, breath, and movement analysis techniques, we seek to develop compelling artistic experiences that encourage the use of the body and singing voice in ways that are physiologically and emotionally beneficial.

Pattie Maes—Fluid Interfaces

How to integrate the world of information and services more naturally into our daily physical lives, enabling insight, inspiration, and interpersonal connections.

218. Augmented Product Counter

Natan Linder, Pattie Maes and Rony Kubat

We have created an augmented reality (AR) based product display counter that transforms any surface or object into an interactive surface, blending digital media and information with physical space. This system enables shoppers to conduct research in the store, learn about product features, and talk to a virtual expert to get advice via built-in video conferencing. The Augmented Product Counter is based on LuminAR technology, which can transform any standard product counter, enabling shoppers to get detailed information on products as well as web access to read unbiased reviews, compare pricing, and conduct research while they interact with real products. This system delivers an innovative in-store shopping experience combining live product interactions in a physical environment with the vast amount of information available on the web in an engaging and interactive manner.

219. Blossom

Pattie Maes and Sajid Sadi

Blossom is a multiperson awareness system that uses ioMaterials-based techniques to connect distant friends and family. It provides an awareness medium that does not rely on the attention- and reciprocity-demanding interfaces that are provided by digital communication media such as mobile phones, SMS, and email. Combining touch-based input with visual, haptic, and motile feedback, Blossoms are created as pairs that can communicate over the network, echoing the conditions of each other and forming an implicit, always-there link that physically express awareness, while retaining the instantaneous capabilities that define digital communication.

220. Community Data Portrait

Pattie Maes and Doug Fritz

As research communities grow, it is becoming increasingly difficult to understand the dynamics of the community; their history and the varying perspective with which they are interpreted. As our information becomes more digital, the histories and artifacts of community become increasingly hidden. The purpose here is to show a given researcher how they fit into the background of a larger community, hopefully strengthening weak ties and understanding. At a high level this project is intended to have real impact by allowing the Media Lab community to reflect on what things it has been working on over the past 25 years and where it should be heading next. On a more individual level this is intended to help researchers within the community situate themselves by better understanding the research directions and interests of their collaborators.

221. Cornucopia: Digital Gastronomy

Marcelo Coelho

Cornucopia is a concept design for a personal food factory, bringing the versatility of the digital world to the realm of cooking. In essence, it is a 3D printer for food that works by storing, precisely mixing, depositing, and cooking layers of ingredients. Cornucopia's cooking process starts with an array of food canisters that refrigerate and store a user's favorite ingredients. These are piped into a mixer and extruder head that can accurately deposit elaborate combinations of food; while this

takes place, the food is heated or cooled. This fabrication process not only allows for the creation of flavors and textures that would be completely unimaginable through other cooking techniques, but it also allows the user to have ultimate control over the origin, quality, nutritional value, and taste of every meal.

Alumni Contributors: William J. Mitchell and Amit Zoran

222. Defuse

Aaron Zinman, Judith Donath and Pattie Maes

Defuse is a commenting platform that rethinks the medium's basic interactions. In a world where a single article in The New York Times can achieve 3,000 comments, the original design of public asynchronous text systems has reached its limit; it needs more than social convention. Defuse uses context to change the basics of navigation and message posting. It uses a combination of machine learning, visualization, and structural changes to achieve this goal.

223. Display Blocks

Pattie Maes and Pol Pla i Conesa

NEW LISTING

Display Blocks is a novel approach to display technology, which consists of arranging six organic light emitting diode screens in a cubic form factor. The aim of the project is to explore the possibilities that this type of display holds for data visualization, manipulation and exploration. The research focuses on exploring how the physicality of the screen can be leveraged to better interpret its contents. To this end, the physical design is accompanied by a series of applications that demonstrate the advantages of this technology.

224. EyeRing: A compact, intelligent vision system on a ring

Suranga Nanayakkara, Roy Shilkrot

EyeRing is a wearable intuitive interface that allows a person to point at an object to see or hear more information about it. We came up with the idea of a micro camera worn as a ring on the index finger with a button on the side, which can be pushed with the thumb to take a picture or a video that is then sent wirelessly to a mobile phone to be analyzed. The user receives information about the object in either auditory or visual form. Future versions of our proposed system may include more sensors to allow non-visual data capture and analysis. This finger-worn configuration of sensors opens up a myriad of possible applications for the visually impaired as well as the sighted.

225. FlexDisplays

Pattie Maes, Juergen Steimle, and Simon Olberding

NEW LISTING

We believe that in the near future many portable devices will have resizable displays. This will allow for devices with a very compact form factor, which can unfold into a large display when needed. In this project, we design and study novel interaction techniques for devices with flexible, rollable, and foldable displays. We explore a number of scenarios, including personal and collaborative uses.

226. Hyperego

Pattie Maes and Aaron Zinman

When we meet new people in real life, we assess them using a multitude of signals relevant to our upbringing, society, and our experiences and disposition. When we encounter a new individual virtually, usually we are looking at a single communication instance in bodiless form. How can we gain a deeper understanding of this individual without the cues we have in real life? Hyperego aggregates information across various online services to provide a more uniform data portrait of the individual. These portraits are at the user's control, allowing specific data to be hidden, revealed, or grouped in aggregate using an innovative privacy model.

227. Inktuitive: An Intuitive Physical Design Workspace

Pranav Mistry and Kayato Sekiya

Despite the advances and advantages of computer-aided design tools, the traditional pencil and paper continue to exist as the most important tools in the early stages of design. Inktuitive is an intuitive physical design workspace that aims to bring together conventional design tools such as paper and pencil with the power and convenience of digital tools for design. Inktuitive also extends the natural work-practice of using physical paper by giving the pen the ability to control the design in physical, 3-D, freeing it from its tie to the paper. The intuition of pen and paper are still present, but lines are captured and translated into shapes in the digital world. The physical paper is augmented with overlaid digital strokes. Furthermore, the platform provides a novel interaction mechanism for drawing and designing using above the surface pen movements.

228. InterPlay: Full-Body Interaction Platform

Pattie Maes, Seth Hunter and Pol Pla i Conesa

InterPlay is a platform for designers to create dynamic social simulations that transform public spaces into immersive environments where people become the central agents. It uses computer vision and projection to facilitate full-body interaction with digital content. The physical world is augmented to create shared experiences that encourage active play, negotiation, and creative composition.

229. ioMaterials

Pattie Maes, Sajid Sadi and Amir Mikhak

ioMaterials is a project encompassing a variety of collocated sensing-actuation platforms. The project explores various aspects of dense sensing for humane communication, memory, and remote awareness. Using dense collocated sensing actuation and sensing, we can change common objects into an interface capable of hiding unobtrusively in plain sight. Relational Pillow and Blossom are instantiations of this ideal.

230. Liberated Pixels

Susanne Seitinger

We are experimenting with systems that blur the boundary between urban lighting and digital displays in public spaces. These systems consist of liberated pixels, which are not confined to rigid frames as are typical urban screens. Liberated pixels can be applied to existing horizontal and vertical surfaces in any configuration, and communicate with each other to enable a different repertoire of lighting and display patterns. We have developed Urban Pixels a wireless infrastructure for liberated pixels. Composed of autonomous units, the system presents a programmable and distributed interface that is flexible and easy to deploy. Each unit includes an on-board battery, RF transceiver unit, and microprocessor. The goal is to incorporate renewable energy sources in future versions.

Alumni Contributor: William J. Mitchell

231. Light.Bodies

Susanne Seitinger, Alex S. Taylor and Microsoft Research

“Light bodies” are mobile and portable, hand-held lights that respond to audio and vibration input. The motivation to build these devices is grounded in a historical reinterpretation of street lighting. Before fixed infrastructure illuminated cities at night, people carried lanterns with them to make their presence known. Using this as our starting point, we asked how we might engage people in more actively shaping the lightscapes which surround them. A first iteration of responsive, LED-based colored lights were designed for use in three different settings including a choreographed dance performance, an outdoor public installation and an audio-visual event.

Alumni Contributor: William J. Mitchell

232. LuminAR

Natan Linder, Pattie Maes and Rony Kubat

LuminAR reinvents the traditional incandescent bulb and desk lamp, evolving them into a new category of robotic, digital information devices. The LuminAR Bulb combines a Pico-projector, camera, and wireless computer in a compact form factor. This self-contained system enables users with just-in-time projected information and a gestural user interface, and it can be screwed into standard light fixtures everywhere. The LuminAR Lamp is an articulated robotic arm, designed to interface with the LuminAR Bulb. Both LuminAR form factors dynamically augment their environments with media and information, while seamlessly connecting with laptops, mobile phones, and other electronic devices. LuminAR transforms surfaces and objects into interactive spaces that blend digital media and information with the physical space. The project radically rethinks the design of traditional lighting objects, and explores how we can endow them with novel augmented-reality interfaces.

233. MemTable

Pattie Maes, Seth Hunter, Alexandre Milouchev and Emily Zhao

MemTable is a table with a contextual memory. The goal of the system is to facilitate reflection on the long-term collaborative work practices of a small group by designing an interface that supports meeting annotation, process documentation, and visualization of group work patterns. The project introduces a tabletop designed both to remember how it is used and to provide an interface for contextual retrieval of information. MemTable examines how an interface that embodies the history of its use can be incorporated into our daily lives in more ergonomic and meaningful contexts.

234. Mouseless

Pranav Mistry and Pattie Maes

Mouseless is an invisible computer mouse that provides the familiarity of interaction of a physical mouse without actually needing a real hardware mouse. Despite the advances in computing hardware technologies, the two-button computer mouse has remained the predominant means to interact with a computer. Mouseless removes the requirement of having a physical mouse altogether, but still provides the intuitive interaction of a physical mouse with which users are familiar.

235. Moving Portraits

Pattie Maes

Moving portrait is a framed portrait that is aware of and reacts to viewers' presence and body movements. A portrait represents a part of our lives and reflects our feelings, but it is completely oblivious to the events that occur around it or to the people who view it. By making a portrait interactive, we create a different and more engaging relationship between it and the viewer.

236. MTM "Little John"

Natan Linder

MTM "Little John" is a multi-purpose, mid-size, rapid prototyping machine with the goal of being a personal fabricator capable of performing a variety of tasks (3D printing, milling, scanning, vinyl cutting) at a price point in the hundreds rather than thousands of dollars. The machine was designed and built in collaboration with the MTM—Machines that Make Project at MIT Center for Bits and Atoms.

237. Perifoveal Display

Valentin Heun, Anette von Kapri and Pattie Maes

NEW LISTING

Today's GUIs are made for small screens with little information shown. Real-time data that goes beyond one small screen needs to be continuously scanned with our eyes in order to create an abstract model of it in one's mind. GUIs therefore do not work with huge amounts of data. The Perifoveal Display takes this abstraction from the user and visualizes it in a way that the full range of vision can be used for data monitoring. This can be realized by taking care of the different visual systems in our eye. Our vision has a field of view from about 120°, which is highly sensitive for motion. 6° of our vision is very slow but complex enough to read text.

238. PoCoMo

Pattie Maes, Seth Hunter and Roy Shilkrot

PoCoMo is an implementation of a vision in future-projected social interfaces. In this project we try to capture the playfulness of collaborative gaming and apply it to projected interfaces. The maturing of handheld micro-projector technology, in conjunction with advanced mobile environments, enable this novel type of interaction. Our system is made of a micro-projector mobile device with a specially designed case that turns it into a first-of-a-kind handheld mini-projector-camera system. Computer Vision algorithms support collaborative interaction between multiple users of the system. Through PoCoMo, we wish to explore the social nature of projected interfaces. To accommodate this we designed the projection to be of human cartoon-like characters that play out a personal interaction. Following their human controllers, they recognize each other, wave hello, shake hands, and exchange presents.

239. PreCursor

Pranav Mistry and Pattie Maes

'PreCursor' is an invisible layer that hovers in front of the screen and enables novel interaction that reaches beyond the current touchscreens. Using a computer mouse provides two levels of depth when interacting with content on a screen. One can just hover or can click. Hover allows receiving short descriptions, while click selects or performs an action. PreCursor provides this missing sense of interaction to touchscreens. PreCursor technology has the potential to expand beyond a basic computer screen. It can also be applied to mobile touchscreens to objects in the real world, or can be the launching pad for creating a 3D space for interaction.

240. Pulp-Based Computing: A Framework for Building Computers Out of Paper

Marcelo Coelho, Pattie Maes, Joanna Berzowska and Lyndl Hall

Pulp-Based Computing is a series of explorations that combine smart materials, papermaking, and printing. By integrating electrically active inks and fibers during the papermaking process, it is possible to create sensors and actuators that behave, look, and feel like paper. These composite materials not only leverage the physical and tactile qualities of paper, but can also convey digital information, spawning new and unexpected application domains in ubiquitous and pervasive computing at extremely affordable costs.

241. Quickies: Intelligent Sticky Notes

Pranav Mistry and Pattie Maes

The goal of Quickies is to bring one of the most useful inventions of the twentieth century into the digital age: the ubiquitous sticky note. Quickies enriches the experience of using sticky notes by linking hand-written sticky notes to mobile phones, digital calendars, task-lists, email, and instant messaging clients. By augmenting the familiar, ubiquitous sticky note, Quickies leverages existing patterns of behavior, merging paper-based sticky note usage with the user's informational experience. The project explores how the use of artificial intelligence (AI), natural language processing (NLP), RFID, and ink-recognition technologies can make it possible to create intelligent sticky notes that can be searched, located, can send reminders and messages, and more broadly, can act as an I/O interface to the digital information world.

242. ReachIn

Anette von Kapri

NEW LISTING

Remote collaboration systems still are far from offering the same rich experience that collocated meetings provide. Collaborators can transmit their voice and face at a distance, but it is very hard to point at physical objects and interpret gestures. In this project we explore how remote collaborators can "reach into" a shared digital space where they can manipulate virtual objects and data. The collaborators see their live video image in a shared 3D virtual space and can point at data such as slides or 3D models and draw on them with virtual pens or alter them with natural gestures.

243. ReflectOns: Mental Prostheses for Self-Reflection

Pattie Maes and Sajid Sadi

ReflectOns are objects that help people think about their actions and change their behavior based on subtle, ambient nudges delivered at the moment of action. Certain tasks—such as figuring out the number of calories consumed, or amount of money spent eating out—are generally difficult for the human mind to grapple with. By using in-place sensing combined with gentle feedback and understanding of users' goals, we can recognize behaviors and trends, and provide a reflection of their own actions tailored to enable both better understanding of the repercussions of those actions, and changes to their behaviors to help them better match their own goals.

244. Remnant: Handwriting Memory Card

Pattie Maes and Sajid Sadi

Remnant is a greeting card that merges the affordances of physical materials with the temporal malleability of digital systems to create, enshrine, and reinforce the very thing that makes a greeting personal: that hand of the sender. The card records both the timing and the form of the sender's handwriting when it is first used. At a later time, collocated output recreates the handwriting, allowing the invisible, memorized hand of the sender to write his or her message directly in front of the recipient.

245. Sensei: A Mobile Tool for Language Learning

Pattie Maes, Suranga Nanayakkara and Roy Shilkrot

Sensei is a mobile interface for language learning (words, sentences, pronunciation). It combines techniques from computer vision, augmented reality, speech recognition, and commonsense knowledge. In the current prototype, the user points his cell phone at an object and then sees the word and hears it pronounced in the language of his choice. The system also shows more information pulled from a commonsense knowledge base. The interface is primarily designed to be used as an interactive and fun language-learning tool for children. Future versions will be applied to other contexts such as real-time language translation for face-to-face communication and assistance to travelers for reading information displays in foreign languages; in addition, future versions will provide feedback to users about whether they are pronouncing words correctly. The project is implemented on a Samsung Galaxy phone running Android, donated by Samsung Corporation.

246. Shutters: A Permeable Surface for Environmental Control and Communication

Marcelo Coelho and Pattie Maes

Shutters is a permeable kinetic surface for environmental control and communication. It is composed of actuated louvers (or shutters) that can be individually addressed for precise control of ventilation, daylight incidence, and information display. By combining smart materials, textiles, and computation, Shutters builds upon other facade systems to create living environments and work spaces that are more energy efficient, while being aesthetically pleasing and considerate of their inhabitants' activities.

247. Siftables: Physical Interaction with Digital Media

Pattie Maes

Siftables are compact electronic devices with motion sensing, graphical display, and wireless communication. One or more Siftables may be physically manipulated to interact with digital information and media. A group of Siftables can thus act in concert to form a physical, distributed, gesture-sensitive, human-computer interface. Each Siftable object is stand-alone (battery-powered and wireless); Siftables do not require installed infrastructure such as large displays, instrumented

tables, or cameras in order to be used. Siftables' key innovation is to give direct physical embodiment to information items and digital media content, allowing people to use their hands and bodies to manipulate these data instead of relying on virtual cursors and windows. By leveraging people's ability to manipulate physical objects, Siftables radically simplify the way we interact with information and media.

Alumni Contributors: Jeevan James Kalanithi and David Merrill

248. Six-Forty by Four-Eighty: An Interactive Lighting System

Marcelo Coelho and Jamie Zigelbaum

Six-Forty by Four-Eighty is an interactive lighting system composed of an array of magnetic physical pixels. Individually, pixel-tiles change their color in response to touch and communicate their state to each other by using a person's body as the conduit for information. When grouped together, the pixel-tiles create patterns and animations that can serve as a tool for customizing our physical spaces. By transposing the pixel from the confines of the screen and into the physical world, focus is drawn to the materiality of computation and new forms for design emerge.

249. SixthSense

Pranav Mistry

Information is often confined to paper or computer screens. SixthSense frees data from these confines and seamlessly integrates information and reality. With the miniaturization of computing devices, we are always connected to the digital world, but there is no link between our interactions with these digital devices and our interactions with the physical world. SixthSense bridges this gap by augmenting the physical world with digital information, bringing intangible information into the tangible world. Using a projector and camera worn as a pendant around the neck, SixthSense sees what you see and visually augments surfaces or objects with which you interact. It projects information onto any surface or object, and allows users to interact with the information through natural hand gestures, arm movements, or with the object itself. SixthSense makes the entire world your computer.

250. SPARSH

Pranav Mistry, Suranga Nanayakkara, and Pattie Maes

SPARSH explores a novel interaction method to seamlessly transfer data among multiple users and devices in a fun and intuitive way. A user touches a data item to be copied from a device, conceptually saving the item in his or her body. Next, the user touches the other device to which he or she wants to paste/pass the saved content. SPARSH uses touch-based interactions as indications for what to copy and where to pass it. Technically, the actual transfer of media happens via the information cloud.

251. Spotlight

Pattie Maes and Sajid Sadi

Spotlight is about an artist's ability to create a new meaning using the combination of interactive portraits and diptych or polyptych layouts. The mere placement of two or more portraits near each other is a known technique to create a new meaning in the viewer's mind. Spotlight takes this concept into the interactive domain, creating interactive portraits that are aware of each other's state and gesture. So not only the visual layout, but also the interaction with others creates a new meaning for the viewer. Using a combination of interaction techniques, Spotlight engages the viewer at two levels. At the group level, the viewer influences the portrait's "social dynamics." At the individual level, a portrait's "temporal gestures" expose much about the subject's personality.

Alumni Contributor: Orit Zuckerman

252. Sprout I/O: A Texturally Rich Interface

Marcelo Coelho and Pattie Maes

Sprout I/O is a kinetic fur that can capture, mediate, and replay the physical impressions we leave in our environment. It combines embedded electronic actuators with a texturally rich substrate that is soft, fuzzy, and pliable to create a dynamic structure where every fur strand can sense physical touch and be individually moved. By developing a composite material that collocates kinetic I/O, while preserving the expectations that we normally have from interacting with physical things, we can more seamlessly embed and harness the power of computation in our surrounding environments to create more meaningful interfaces for our personal and social activities.

253. Surflex: A Shape-Changing Surface

Marcelo Coelho and Pattie Maes

Surflex is a programmable surface for the design and visualization of physical objects and spaces. It combines the different memory and elasticity states of its materials to deform and gain new shapes, providing a novel alternative for 3-D fabrication and the design of physically adaptable interfaces.

254. Swyp

Natan Linder and Alexander List

NEW LISTING

With Swyp you can transfer any file from any app to any app on any device: simply with a swipe of a finger. Swyp is a framework facilitating cross-app, cross-device data exchange using physical "swipe" gestures. Our framework allows any number of touch-sensing and collocated devices to establish file-exchange and communications with no pairing other than a physical gesture. With this inherent physical paradigm, users can immediately grasp the concepts behind device-to-device communications. Our prototypes application Postcards explore touch-enabled mobile devices connected to the LuminAR augmented surface interface. Postcards allows users to collaborate and create a digital postcards using Swyp interactions. We demonstrate how Swyp enabled interfaces can support new generation of interactive workspaces possible by allowing pair-free gesture-based communications to and from collocated devices.

255. TaPuMa: Tangible Public Map

Pranav Mistry and Tsuyoshi Kuroki

TaPuMa is a digital, tangible, public map that allows people to use everyday objects they carry to access relevant, just-in-time information and to find locations of places or people. TaPuMa envisions that conventional maps can be augmented with the unique identities and affordances of the objects. TaPuMa uses an environment where map and dynamic content is projected on a tabletop. A camera mounted above the table identifies and tracks the locations of the objects on the surface, and a software program identifies and registers the location of objects. After identifying the objects, the software provides relevant information visualizations directly on the table. The projector augments both object and table with projected digital information. TaPuMa explores a novel interaction mechanism where physical objects are used as interfaces to digital information. It allows users to acquire information through tangible media, the things they carry.

256. TeleKinect

Seth Hunter

NEW LISTING

TeleKinect is a peer to peer software for creative tele-video interactions. The environment can be used to have more playful video interactions at a distance, record live animations, and facilitate parent child interactions. The system tracks gestures and objects in the local environment and maps them to virtual objects and characters. It allows users to creatively bridge the physical and digital meeting spaces by defining their own mappings.

257. Textura

Pattie Maes, Marcelo Coelho and Pol Pla i Conesa

Textura is an exploration of how to enhance white objects with textures. By projecting onto any white surface, we can simulate different textures and materials. We envision this technology to have great potential for customization and personalization, and to be applicable to areas such as industrial design, the game industry, and retail scenarios.

258. The Relative Size of Things

Marcelo Coelho and Pattie Maes

The Relative Size of Things is a low-cost 3D scanner for the microscopic world. It combines a webcam, a three-axis computer-controlled plotter, and image processing to merge hundreds of photographs into a single three-dimensional scan of surface features which are invisible to the naked eye.

259. thirdEye

Pranav Mistry and Pattie Maes

thirdEye is a new technique that enables multiple viewers to see different things on a same display screen at the same time. With thirdEye: a public sign board can show a Japanese tourist instructions in Japanese and an American in English; games won't need a split screen anymore—each player can see his or her personal view of the game on the screen; two people watching TV can watch their favorite channel on a single screen; a public display can show secret messages or patterns; and in the same movie theater, people can see different ends of a suspense movie.

260. Transitive Materials: Towards an Integrated Approach to Material Technology

Pattie Maes, Marcelo Coelho, Neri Oxman, Sajid Sadi, Amit Zoran and Amir Mikhak

Transitive Materials is an umbrella project encompassing novel materials, fabrication technologies, and traditional craft techniques that can operate in unison to create objects and spaces that realize truly omnipresent interactivity. We are developing interactive textiles, ubiquitous displays, and responsive spaces that seamlessly couple input, output, processing, communication, and power distribution, while preserving the uniqueness and emotional value of physical materials and traditional craft. Life in a Comic, Physical Heart in a Virtual Body, Augmented Pillows, Flexible Urban Display, Shutters, Sprout I/O, and Pulp-Based Computing are current instantiations of these technologies.

261. VisionPlay

Pattie Maes and Seth Hunter

VisionPlay is a framework to support the development of augmented play experiences for children. We are interested in exploring mixed reality applications enabled by web cameras, computer vision techniques, and animation that are more socially oriented and physically engaging. These include using physical toys to control digital characters, augmenting physical play environments with projection, and merging representations of the physical world with virtual play spaces.

262. Watt Watcher

Pattie Maes, Sajid Sadi and Eben Kunz

Energy is the backbone of our technological society, yet we have great difficulty understanding where and how much of it is used. Watt Watcher is a project that provides in-place feedback on aggregate energy use per device in a format that is easy to understand and intuitively compare. Energy is inherently invisible, and its use is often sporadic and difficult to gauge. How much energy does your laptop use compared to your lamp? Or perhaps your toaster? By giving users some intuition regarding these basic questions, this ReflectOn allows users both to understand their use patterns and form new, more informed habits.

Frank Moss—New Media Medicine

How radical new collaborations will catalyze a revolution in health.

263. CollaboRhythm

Frank Moss, John Moore MD, Scott Gilroy, Joslin Diabetes Clinic, UMass Medical School, Department of Veterans Affairs, Children's Hospital Boston, Boston Medical Center

CollaboRhythm is a platform that enables patients to be at the center of every interaction in their healthcare with the goal of empowering them to be involved, reflective, and proactive. Care can be coordinated securely through cell phones, tablets, televisions, and computers so that support can be provided in real-time in the real world instead of through inconvenient doctor's office visits. We are currently developing and demonstrating applications for diabetes and hypertension management. A number of third parties have also developed exciting applications using CollaboRhythm. Please visit http://newmed.media.mit.edu to learn about how you can build a project with us using CollaboRhythm.

264. Collective Discovery

Frank Moss and Ian Eslick

The choices we make about diet, environment, medications, or alternative therapies constitute a massive collection of "everyday experiments." These data remain largely unrecorded and are underutilized by traditional research institutions. Collective Discovery aims to leverage the intuition and insight of patient communities to generate datasets about everyday experiences. We emphasize patient use of the experimental process by tracking and assessing the impact of everyday experiments on their bodies and lives. Large-scale datasets of such interventions yield powerful predictors that will lead to better individual decision-making, stronger self-advocacy, identification of novel therapies, and inspire better hypotheses in the traditional research context, accelerating the search for new drugs and therapies.

265. ForgetAboutIT?

John Moore MD and Frank Moss

ForgetAboutIT has become an integrated part of CollaboRhythm. Currently only 50% of patients with chronic diseases take their medications. The problem is not simple forgetfulness; it is a complex combination of lack of understanding, poor self-reflection, limited social support, and almost non-existent communication between provider and patient. ForgetAboutIT? is a system to support medication adherence which presupposes that patients engaged in tight, collaborative communication with their providers through interactive interfaces would think it preposterous not to take their medications. Technically, it is an awareness system that employs ubiquitous connectivity on the patient side through cell phones, televisions, and other interactive devices and a multi-modal collaborative workstation on the provider side.

266. I'm Listening

John Moore MD, Henry Lieberman and Frank Moss

Increasing understanding of how to categorize patient symptoms for efficient diagnosis has led to structured patient interviews and diagnostic flowcharts that can provide diagnostic accuracy and save valuable physician time. But the rigidity of predefined questions and controlled vocabulary for answers can leave patients feeling over-constrained, as if the doctor (or computer system) is not really attending to them. I'm Listening is a system for automatically conducting patient pre-visit interviews. It does not replace a human doctor, but can be used before an office visit to prepare

the patient, deliver educational materials or triage care, and preorder appropriate tests, making better use of both doctor and patient time. It uses an on-screen avatar and natural language processing to (partially) understand the patient's response. Key is a common-sense reasoning system that lets patients express themselves in unconstrained natural language, even using metaphor, and that maps the language to medically relevant categories.

267. Oovit PT

Mar Gonzalez, John Moore, and Frank Moss

Patient adherence to physical therapy regimens is poor, and there is a lack of quantitative data about patient performance, particularly at home. This project is an end-to-end virtual rehabilitation system for supporting patient adherence to home exercise that addresses the multi-factorial nature of the problem. The physical therapist and patient make shared decisions about appropriate exercises and goals and patients use a sensor-enabled gaming interface at home to perform exercises. Quantitative data is then fed back to the therapist, who can properly adjust the regimen and give reinforcing feedback and support.

Neri Oxman—Mediated Matter

How digital and fabrication technologies mediate between matter and environment to radically transform the design and construction of objects, buildings, and systems.

268. 3D Printing of Functionally Graded Materials

Neri Oxman and Steven Keating

Functionally graded materials–materials with spatially varying composition or microstructure–are omnipresent in nature. From palm trees with radial density gradients, to the spongy trabeculae structure of bone, to the hardness gradient found in many types of beaks, graded materials offer material and structural efficiency. But in man-made structures such as concrete pillars, materials are typically volumetrically homogenous. While using homogenous materials allows for ease of production, improvements in strength, weight, and material usage can be obtained by designing with functionally graded materials. To achieve graded material objects, we are working to construct a 3D printer capable of dynamic mixing of composition material. Starting with concrete and UV-curable polymers, we aim to create structures, such as a bone-inspired beam, which have functionally graded materials.

269. Beast

Neri Oxman

Beast is an organic-like entity created synthetically by the incorporation of physical parameters into digital form-generation protocols. A single continuous surface, acting both as structure and as skin, is locally modulated for both structural support and corporeal aid. Beast combines structural, environmental, and corporeal performance by adapting its thickness, pattern density, stiffness, flexibility, and translucency to load, curvature, and skin-pressured areas respectively.

270. Building-Scale 3D Printing

NEW LISTING

Neri Oxman and Steven Keating

How can additive fabrication technologies be scaled to building-sized construction? We introduce a novel method of mobile swarm printing that allows small robotic agents to construct large structures. The robotic agents extrude a fast curing material which doubles as both a concrete mold for structural walls and as a thermal insulation layer. This technique offers many benefits over traditional construction methods, such as speed, custom geometry, and cost. As well, direct integration of building utilities like wiring and plumbing can be incorporated into the printing process.

271. Carpal Skin

Neri Oxman

Carpal Skin is a prototype for a protective glove to protect against Carpal Tunnel Syndrome, a medical condition in which the median nerve is compressed at the wrist, leading to numbness, muscle atrophy, and weakness in the hand. Night-time wrist splinting is the recommended treatment for most patients before going into carpal tunnel release surgery. Carpal Skin is a process by which to map the pain-profile of a particular patient—its intensity and duration—and to distribute hard and soft materials to fit the patient’s anatomical and physiological requirements, limiting movement in a customized fashion. The form-generation process is inspired by animal coating patterns in the control of stiffness variation.

272. CNSILK: Computer Numerically Controlled Silk Cocoon Construction

Neri Oxman

CNSILK explores the design and fabrication potential of silk fibers—inspired by silkworm cocoons—for the construction of woven habitats. It explores a novel approach to the design and fabrication of silk-based building skins by controlling the mechanical and physical properties of spatial structures inherent in their microstructures using multi-axes fabrication. The method offers construction without assemblies such that material properties vary locally to accommodate for structural and environmental requirements. This approach stands in contrast to functional assemblies and kinetically actuated facades which require a great deal of energy to operate, and are typically maintained by global control. Such material architectures could simultaneously bear structural load, change their transparency so as to control light levels within a spatial compartment (building or vehicle), and open and close embedded pores so as to ventilate a space.

273. Digitally Reconfigurable Forming Surface

Neri Oxman, Benjamin Peters and Eric Marion

The digitally reconfigurable surface is a mechanism for directly creating 3D, contoured surfaces from a computer-aided design (CAD) input. A digital design is uploaded into the device, and a grid of thousands of tiny pins–much like the popular pin-art toy–are actuated up and down to form the desired surface. A rubber sheet is held by vacuum pressure onto the tops of the pins to smooth out the surface formed by them; this surface can then be used for industrial forming operations, simple resin casting, and many other applications. The unique phase-changing clutching actuation at the heart of the device allows it to have very small pins and to create strong surfaces at a high resolution. This technique for distributed pin actuation is the first of its kind, and has the potential to make low-cost, high-resolution, reconfigurable molds available to consumers.

274. FABRICOLOGY: Variable-Property 3D Printing as a Case for Sustainable Fabrication

Neri Oxman

Rapid prototyping technologies speed product design by facilitating visualization and testing of prototypes. However, such machines are limited to using one material at a time; even high-end 3D printers, which accommodate the deposition of multiple materials, must do so discretely and not in mixtures. This project aims to build a proof-of-concept of a 3D printer able to dynamically mix and vary the ratios of different materials in order to produce a continuous gradient of material properties with real-time correspondence to structural and environmental constraints.

Alumni Contributors: Mindy Eng, William J. Mitchell and Rachel Fong

275. Monocoque

Neri Oxman

French for "single shell," Monocoque stands for a construction technique that supports structural load using an object's external skin. Contrary to the traditional design of building skins that distinguish between internal structural frameworks and non-bearing skin elements, this approach promotes heterogeneity and differentiation of material properties. The project demonstrates the notion of a structural skin using a Voronoi pattern, the density of which corresponds to multi-scalar loading conditions. The distribution of shear-stress lines and surface pressure is embodied in the allocation and relative thickness of the vein-like elements built into the skin. Its innovative 3D printing technology provides for the ability to print parts and assemblies made of multiple materials within a single build, as well as to create composite materials that present preset combinations of mechanical properties.

276. Morphable Structures

Neri Oxman and Steven Keating

Granular materials can be put into a jammed state through the application of pressure to achieve a pseudo-solid material with controllable rigidity and geometry. While jamming principles have been long known, large-scale applications of jammed structures have not been significantly explored. The possibilities for shape-changing machines and structures are vast and jamming provides a plausible mechanism to achieve this effect. In this work, jamming prototypes are constructed to gain a better understanding of this effect. As well, potential specific applications are highlighted and demoed. Such applications range from a morphable chair, to a floor which dynamically changes its softness in response to a user falling down to reduce injury, to artistic free-form sculpting.

277. Rapid Craft

Neri Oxman

The values endorsed by vernacular architecture have traditionally promoted designs constructed and informed by and for the environment while using local knowledge and indigenous materials. Under the imperatives and growing recognition of sustainable design, Rapid Craft seeks the integration sought between local construction techniques and globally available digital design technologies to preserve, revive, and reshape these cultural traditions.

278. Raycounting

Neri Oxman

Raycounting is a method for generating customized light-shading constructions by registering the intensity and orientation of light rays within a given environment. 3D surfaces of double curvature are the result of assigning light parameters to flat planes. The algorithm calculates the intensity, position and direction of one, or multiple, light sources placed in a given environment and assigns local curvature values to each point in space corresponding to the reference plane and the light dimension. Light performance analysis tools are reconstructed programmatically to allow for morphological synthesis based on intensity, frequency and polarization of light parameters as defined by the user.

279. Robotic Light Expressions

NEW LISTING

Neri Oxman and Steven Keating

We are exploring new modalities of creative photography through robotics and long-exposure photography. Using a robotic arm, a light source is carried through precise movements in front of a camera. Photographic compositions are recorded as images of volumetric light. Robotic light "painting" can also be inverted: the camera is moved via the arm to create an image "painted" with environmental light. Finally, adding real-time sensor input to the moving arm and programming it to explore the physical space around objects can reveal immaterial fields like radio waves, magnetic fields, and heat flows.

280. Spiderbot

NEW LISTING

Neri Oxman and Benjamin Peters

Spiderbot is a cable-suspended robotic gantry system that provides an easily deployable platform from which to print large structures. The body is an extrusion nozzle, a reservoir of material, and parallel winching motors. Cables from the robot are connected to stable points high in the environment, such as large trees or buildings. This actuation arrangement is capable of moving large distances without the need for more expensive and cumbersome linear guides, much like a spider does. The system is easy to set up for mobile projects, but will afford sufficient printing resolution and build volume. Expanding foam can be deposited to create a building-scale printed object rapidly. Another material type of interest is the extrusion or spinning of tension elements, like rope or cable. With tension elements, unique structures such as bridges or webs can be wrapped, woven, or strung around environmental features or previously printed materials.

Joseph Paradiso—Responsive Environments

How sensor networks augment and mediate human experience, interaction, and perception.

281. A Machine Learning Toolbox for Musician Computer Interaction

NEW LISTING

Joe Paradiso and Nick Gillian

The SEC is an extension to the free open-source program EyesWeb that contains a large number of machine learning and signal processing algorithms that have been specifically designed for real-time pattern and gesture recognition. All the algorithms within the SEC are encapsulated as individual blocks, allowing the user to connect the output of one block to the input of another to create a signal flow chain. This allows a user to quickly build and train their own custom gesture recognition system, without having to write a single line of code or explicitly understand how any of the machine learning algorithms within their recognition system work.

282. Beyond the Light Switch: New Frontiers in Dynamic Lighting

Matthew Aldrich

Advances in building technology and sensor networks offer a chance to imagine new forms of personalized and efficient utility control. One such area is lighting control. With the aid of sensor networks, these new control systems not only offer lower energy consumption, but also enable new ways to specify and augment lighting. It is our belief that dynamic lighting controlled by a single user, or even an entire office floor, is the frontier of future intelligent and adaptive systems.

283. Chameleon Guitar: Physical Heart in a Virtual Body

Joe Paradiso and Amit Zoran

How can traditional values be embedded into a digital object? We explore this concept by implementing a special guitar that combines physical acoustic properties with virtual capabilities. The acoustical values will be embodied by a wooden heart—a unique, replaceable piece of wood that will give the guitar a unique sound. The acoustic signal created by this wooden heart will be digitally processed in order to create flexible sound design.

284. Customizable Sensate Surface for Music Control

NEW LISTING

Joe Paradiso, Nan-Wei Gong and Nan Zhao

We developed a music control surface which enables integration between any musical instruments via a versatile, customizable, and inexpensive user interface. This sensate surface allows capacitive sensor electrodes and connections between electronics components to be printed onto a large roll of flexible substrate unrestricted in length. The high dynamic range capacitive sensing electrodes can not only infer touch, but near-range, non-contact gestural nuance in a music performance. With this sensate surface, users can “cut” out their desired shapes, “paste” the number of inputs, and customize their controller interfaces, which can then send signals wirelessly to effects or software synthesizers. We seek to find a solution for integrating the form factor of traditional music controllers seamlessly on top of one’s instrument while adding expressiveness to performance by sensing and incorporating movements and gestures to manipulate the musical output.

285. Data-Driven Elevator Music

Joe Paradiso, Gershon Dublon, Nicholas Joliat, Brian Mayton and Ben Houge (MIT Artist in Residence)

Our new building lets us see across spaces, extending our visual perception beyond the walls that enclose us. Yet, invisibly, networks of sensors, from HVAC and lighting systems to Twitter and RFID, control our environment and capture our social dynamics. This project proposes extending our senses into this world of information, imagining the building as glass in every sense. Sensor devices distributed throughout the Lab transmit privacy-protected audio streams and real-time measurements of motion, temperature, humidity, and light levels. The data are composed into an eight-channel audio installation in the glass elevator that turns these dynamic parameters into music, while microphone streams are spatialized to simulate their real locations in the building. A pressure sensor in the elevator provides us with fine-grained altitude to control the spatialization and sonification. As visitors move from floor to floor, they hear the activities taking place on each.

286. Dense, Low-Power Environmental Monitoring for Smart Energy Profiling

Nan-Wei Gong, Ashley Turza, David Way and Joe Paradiso with: Phil London, Gary Ware, Brett Leida and Tim Ren (Schneider Electric); Leon Glicksman and Steve Ray (MIT Building Technologies)

We are working with sponsor Schneider Electric to deploying a dense, low-power wireless sensor network aimed at environmental monitoring for smart energy profiling. This distributed sensor system measures temperature, humidity, and 3D airflow, and transmits this information through a wireless Zigbee protocol. These sensing units are currently deployed in the lower atrium of E14. The data is being used to inform CFD models of airflow in buildings, explore and retrieve valuable information regarding the efficiency of commercial building HVAC systems, energy efficiency of different building materials, and lighting choices in novel architectural designs.

287. Digito: A Fine-Grained, Gesturally Controlled Virtual Musical Instrument

NEW LISTING

Joe Paradiso and Nick Gillian

Digito is a gesturally controlled virtual musical instrument, controlled through a number of intricate hand gestures which provide both discrete and continuous control of its sound engine. The hand gestures are captured using a 3D depth sensor and recognized using computer vision and machine learning algorithms. Digito is currently being used to evaluate the possible strengths and limitations of gesturally controlled virtual musical instruments and to assist in uncovering new questions regarding the design of gestural musical interfaces.

288. DoppelLab: Spatialized Sonification in a 3D Virtual Environment

Joe Paradiso, Nicholas Joliat, Brian Mayton, Gershon Dublon, and Ben Houge (MIT Artist in Residence)

In DoppelLab, we are developing tools that intuitively and scalably represent the rich, multimodal sensor data produced by a building and its inhabitants. Our aims transcend the traditional graphical display, in terms of the richness of data conveyed and the immersiveness of the user experience. To this end, we have incorporated 3D spatialized data sonification into the DoppelLab application, as well as in standalone installations. Currently, we virtually spatialize streams of audio recorded by nodes throughout the physical space. By reversing and shuffling short audio segments, we distill the sound to its ambient essence while protecting occupant privacy. In addition to the sampled audio, our work includes abstract data sonification that conveys multimodal sensor data. As part of this work, we are collaborating with the internationally active composer and MIT artist-in-residence Ben Houge, towards new avenues for cross-reality data sonification and aleatoric musical composition.

289. DoppelLab: Tools for Exploring and Harnessing Multimodal Sensor Network Data

Joe Paradiso, Gershon Dublon, Laurel Smith Pardue, Brian Mayton, Nicholas Joliat, and Noah Swartz

Homes and offices are being filled with sensor networks to answer specific queries and solve pre-determined problems, but no comprehensive visualization tools exist for fusing these disparate data to examine relationships across spaces and sensing modalities. DoppelLab is an immersive, cross-reality virtual environment that serves as an active repository of the multimodal sensor data produced by a building and its inhabitants. We transform architectural models into browsing environments for real-time sensor data visualization and sonification, as well as open-ended platforms for building audiovisual applications atop those data. These applications in turn become sensor-driven interfaces to physical world actuation and control. DoppelLab encompasses a set of tools for parsing, visualization, sonification, and application development, and by organizing data by the space from which they originate, DoppelLab provides a platform to make both broad and specific queries about the activities, systems, and relationships in a complex, sensor-rich environment.

290. Expressive Re-Performance

Joe Paradiso, Nick Gillian and Laurel Smith Pardue

Expressive musical re-performance is about enabling a person to experience the creative aspects of a playing a favorite song regardless of technical expertise. This is done by providing users with computer-linked electronic instruments that distills the instruments' interface but still allows them to provide expressive gesture. The next note in an audio source is triggered on the instrument, with the computer providing correctly pitched audio and mapping the expressive content onto it. Thus, the physicality of the instrument remains, but requires far less technique. We are implementing an expressive re-performance system using commercially available, expressive electronic musical instruments and an actual recording as the basis for deriving audio. Performers will be able to select a voice within the recording and re-perform the song with the targeted line subject to their own creative and expressive impulse.

291. Feedback Controlled Solid State Lighting

Joe Paradiso and Matt Aldrich

At present, luminous efficacy and cost remain the greatest barriers to broad adoption of LED lighting. However, it is anticipated that within several years, these challenges will be overcome. While we may think our basic lighting needs have been met, this technology offers many more opportunities than just energy efficiency: this research attempts to alter our expectations for lighting and cast aside our assumptions about control and performance. We will introduce new, low-cost sensing modalities that are attuned to human factors such as user context, circadian rhythms, or productivity, and integrate these data with atypical environmental factors to move beyond traditional lux measurements. To research and study these themes, we are focusing on the development of superior color-rendering systems, new power topologies for LED control, and low-cost multimodal sensor networks to monitor the lighting network as well as the environment.

292. FreeD

Joe Paradiso and Amit Zoran

The FreeD is a hand-held, digitally controlled, milling device that is guided and monitored by a computer while still preserving the craftsperson's freedom to sculpt and carve. The computer will intervene only when the milling bit approaches the planned model. Its interaction is either by slowing down the spindle speed or by drawing back the shaft; the rest of the time it allows complete freedom, letting the user to manipulate and shape the work in any creative way.

293. Funk2: Causal Reflective Programming

Joe Paradiso and Bo Morgan

Funk2 is a novel process-description language that keeps track of everything that it does. Remembering these causal execution traces allows parallel threads to reflect, recognize, and react to the history and status of other threads. Novel forms of complex, adaptive, nonlinear control algorithms can be written in the Funk2 programming language. Currently, Funk2 is implemented to take advantage of distributed grid processors consisting of a heterogeneous network of computers, so that hundreds of thousands of parallel threads can be run concurrently, each using many gigabytes of memory. Funk2 is inspired by Marvin Minsky's Critic-Selector theory of human cognitive reflection.

294. Hackable, High-Bandwidth Sensory Augmentation

NEW LISTING

Joe Paradiso and Gershon Dublon

The tongue has extremely dense sensing resolution, as well as an extraordinary degree of neuroplasticity (the ability to adapt to and internalize new input). Research has shown that electro-tactile tongue displays paired with cameras can be used as vision prosthetics for the blind or visually impaired; users quickly learn to read and navigate through natural environments, and many describe the signals as an innate sense. However, existing displays are expensive and difficult to adapt. Tongueduino is an inexpensive, vinyl-cut tongue display designed to interface with many types of sensors besides cameras. Connected to a magnetometer, for example, the system provides a user with an internal sense of direction, like a migratory bird. Piezo whiskers

allow a user to sense orientation, wind, and the lightest touch Through tongueduino, we hope to bring electro-tactile sensory substitution beyond the discourse of vision replacement, toward open-ended sensory augmentation.

295. Patchwerk: Multi-User Network Control of a Massive Modular Synth

NEW LISTING

Joe Paradiso, Gershon Dublon, Nicholas Joliat and Brian Mayton

Patchwerk is a networked synthesizer module with tightly coupled web browser and tangible interfaces. Patchwerk connects to a pre-existing modular synthesizer using the emerging cross-platform HTML5 WebSocket standard to enable low-latency, high-bandwidth, concurrent control of analog signals by multiple users. Online users control physical outputs on a custom-designed cabinet that reflects their activity through a combination of motorized knobs and LEDs, and streams the resultant audio. In a typical installation, a composer creates a complex physical patch on the modular synth that exposes a set of analog and digital parameters (knobs, buttons, toggles, and triggers) to the web-enabled cabinet. Both physically present and online audiences can control those parameters, simultaneously seeing and hearing the results of each other's actions. By enabling collaborative interaction with a massive analog synthesizer, Patchwerk brings a broad audience closer to a rare and historically important instrument.

296. Personal Video Layers for Privacy

Joe Paradiso and Gershon Dublon

We are developing an opt-in camera network, in which users carrying wearable tags are visible to the network and everyone else is invisible. Existing systems for configurable dynamic privacy in this context are opt-out and catch-all; users desiring privacy carry pre-registered tags that disable sensing and networked media services for everyone in the room. To address these issues, we separate video into layers of flexible sprites representing each person in the field of view, and transmit video of only those who opt-in. Our system can also define groups of users who can be dialed in and out of the video stream dynamically. For cross-reality applications, these dynamic layers achieve a new level of video granularity, allowing users and groups to uncover correspondences between their activities across spaces.

297. Rapidnition: Rapid User-Customizable Gesture Recognition

NEW LISTING

Joe Paradiso and Nick Gillian

Rapidnition is a new way of thinking about gesturally controlled interfaces. Rather than forcing users to adapt their behavior to a predefined gestural interface, Rapidnition frees users to define their own gestures, which the system rapidly learns. The machine learning algorithms at the core of Rapidnition enable it to quickly infer a user’s gestural vocabulary, using a small number of user-demonstrated examples of each gesture. Rapidnition is capable of recognizing not just static postures but also dynamic temporal gestures. In addition, Rapidnition allows the user to define complex, nonlinear, continuous-mapping spaces. Rapidnition is currently being applied to the real-time recognition of musical gestures to rigorously test both the discrete and continuous recognition abilities of the system.

298. Scalable and Versatile Surface for Ubiquitous Sensing

Joe Paradiso, Nan-Wei Gong and Steve Hodges (Microsoft Research Cambridge)

We demonstrate the design and implementation of a new versatile, scalable, and cost-effective sensate surface. The system is based on a new conductive inkjet technology, which allows capacitive sensor electrodes and different types of RF antennas to be cheaply printed onto a roll of flexible substrate that may be many meters long. By deploying this surface on (or under) a floor it is possible to detect the presence and whereabouts of users through both passive and active capacitive coupling schemes. We have also incorporated GSM and NFC electromagnetic radiation sensing and piezoelectric pressure and vibration detection. We believe that this technology has the potential to change the way we think about covering large areas with sensors and associated electronic circuitry–not just floors, but potentially desktops, walls, and beyond.

299. TRUSS: Tracking Risk with Ubiquitous Smart Sensing

Joe Paradiso, Gershon Dublon and Brian Dean Mayton

We are developing a system for inferring safety context on construction sites by fusing data from wearable devices, distributed sensing infrastructure, and video. Wearable sensors stream real-time levels of dangerous gases, dust, noise, light quality, precise altitude, and motion to base stations that synchronize the mobile devices, monitor the environment, and capture video. Context mined from these data is used to highlight salient elements in the video stream for monitoring and decision support in a control room. We tested our system in a initial user study on a construction site, instrumenting a small number of steel workers and collecting data. A recently completed hardware revision will be followed by further user testing and interface development.

300. Wearable, Wireless Sensor System for Sports Medicine and Interactive Media

Joe Paradiso, Michael Thomas Lapinski, Dr. Eric Berkson and MGH Sports Medicine

This project is a system of compact, wearable, wireless sensor nodes, equipped with full six-degree-of-freedom inertial measurement units and node-to-node capacitive proximity sensing. A high-bandwidth, channel-shared RF protocol has been developed to acquire data from many (e.g., 25) of these sensors at 100 Hz full-state update rates, and software is being developed to fuse this data into a compact set of descriptive parameters in real time. A base station and central computer clock the network and process received data. We aim to capture and analyze the physical movements of multiple people in real time, using unobtrusive sensors worn on the body. Applications abound in biomotion analysis, sports medicine, health monitoring, interactive exercise, immersive gaming, and interactive dance ensemble performance.

Alumni Contributors: Ryan Aylward and Mathew Laibowitz

301. WristQue: A Personal Wristband for Sensing and Smart Infrastructure

Joe Paradiso and Brian Mayton

While many wearable sensors have been developed, few are actually worn by people on a regular basis. WristQue is a wristband sensor that is comfortable and customizable to encourage widespread adoption. The hardware is 3D printable, giving users a choice of materials and colors. Internally, the wristband will include a main board with microprocessor, standard sensors, and localization/wireless communication, and an additional expansion board that can be replaced to customize functionality of the device for a wide variety of applications. Environmental sensors (temperature, humidity, light) combined with fine-grained indoor localization will enable smarter building infrastructure, allowing HVAC and lighting systems to optimize to the locations and ways that people are actually using the space. Users' preferences can be input through buttons on the wristband. Fine-grained localization also opens up possibilities for larger applications, such as visualizing building usage through DoppelLab and smart displays that react to users' presence.

Alex (Sandy) Pentland—Human Dynamics

How social networks can influence our lives in business, health, and governance, as well as technology adoption and diffusion.

302. Economic Decision-Making in the Wild

Alex (Sandy) Pentland and Katherine Krumme

How predictable are people? We are using credit card transaction data to look at how patterns of human behavior change over time and space, and with which macroeconomic features these changes correlate. How does spending/merchant composition evolve as a region gets bigger/richer/more economically diverse? Do network features help to predict economic ones?

303. Funf: Open Sensing Framework

Alex (Sandy) Pentland, Nadav Aharony, Wei Pan, Cody Sumter and Alan Gardner

The Funf open sensing framework is an Android-based extensible framework for phone-based mobile sensing. The core concept is to provide a reusable set of functionalities enabling collection, uploading, and configuration for a wide range of data types. Funf Journal is an Android application for researchers, self-trackers, and anyone interested in collecting and exploring information related to the mobile device, its environment, and its user's behavior. It is built using the Funf framework and makes use of many of its built-in features.

304. Sensible Organizations

Alex (Sandy) Pentland, Benjamin Waber and Daniel Olguin Olguin

Data mining of email has provided important insights into how organizations function and what management practices lead to greater productivity. But important communications are almost always face-to-face, so we are missing the greater part of the picture. Today, however, people carry cell phones and wear RFID badges. These body-worn sensor networks mean that we can potentially know who talks to whom, and even how they talk to each other. Sensible Organizations investigates how these new technologies for sensing human interaction can be used to reinvent organizations and management.

305. Social Evolution

Alex (Sandy) Pentland and Wen Dong

How do opinions and behaviors spread in face-to-face networks? In this project, we measure the spread of political opinions, influenza and common colds, stress and loneliness, and weight changes from 320,000 hours of automated sensor data. These characteristic variations in individual behavior and network structure can be used to accurately predict outcomes across various different contexts.

Alumni Contributors: Anmol Madan and Iolanthe Chronis

306. Social Signals in Biomedicine

Max Little

We are using non-invasive measurement of social signals found in voice, body movement, and location to quantify symptoms in neurological disorders such as Parkinson's Disease.

307. The Friends and Family Study

Alex (Sandy) Pentland Wei Pan

The Friends and Family Study (Funf) is a long-term, mobile phone-based experiment that has transformed a graduate family community into a living lab for social-science investigation. Data from this study, collected via Android-based phones equipped with our software platform for passive data collection, will be used to look at issues including individual and group identity, real-world decision making, social diffusion, social health, and boundaries of privacy. The experiment began in March 2010, and continues through the 2011 academic year. The Funf dataset is one of the world's most comprehensive social-science datasets to date, and will allow researchers to investigate a wide range of social and behavioral questions. The Funf Android data collection software is a platform that can be reused for future studies and applications.

Rosalind W. Picard—Affective Computing

How new technologies can help people better communicate, understand, and respond to affective information.

308. AMA: A Tool for Annotation, Monitoring, and Analysis

Matthew Goodwin, Rosalind W. Picard, Javier Hernandez Rivera and Akane Sano

AMA is an Android application that allows users to make customizable multi-modal annotations and monitor physiological signals. This work was proposed to improve understanding of problem behavior in people with Autism Spectrum Disorders.

309. Analysis of Autonomic Sleep Patterns

Akane Sano, Rosalind W. Picard, Suzanne E. Goldman, Beth A. Malow (Vanderbilt) Rana el Kaliouby, and Robert Stickgold (Harvard)

We are examining autonomic sleep patterns using a wrist-worn biosensor that enables comfortable measurement of skin conductance, skin temperature, and motion. The skin conductance reflects sympathetic arousal. We are looking at sleep patterns in healthy groups, in groups with autism, and in groups with sleep disorders. We are looking especially at sleep quality and at performance on learning and memory tasks.

310. Auditory Desensitization Games

Rosalind W. Picard, Matthew Goodwin and Rob Morris

Persons on the autism spectrum often report hypersensitivity to sound. Efforts have been made to manage this condition, but there is wide room for improvement. One approach—exposure therapy—has promise, and a recent study showed that it helped several individuals diagnosed with autism overcome their sound sensitivities. In this project, we borrow principles from exposure therapy, and use fun, engaging, games to help individuals gradually get used to sounds that they might ordinarily find frightening or painful.

311. Automatic Stress Recognition in Real-Life Settings

Rosalind W. Picard, Robert Randall Morris and Javier Hernandez Rivera

Technologies to automatically recognize stress, are extremely important to prevent chronic psychological stress and the pathophysiological risks associated to it. The introduction of comfortable and wearable biosensors have created new opportunities to measure stress in real-life environments, but there is often great variability in how people experience stress and how they express it physiologically. In this project, we modify the loss function of Support Vector Machines to encode a person's tendency to feel more or less stressed, and give more importance to the training samples of the most similar subjects. These changes are validated in a case study where skin conductance was monitored in nine call center employees during one week of their regular work. Employees working in this type of settings usually handle high volumes of calls every day, and they frequently interact with angry and frustrated customers that lead to high stress levels.

312. Cardiocam

Ming-Zher Poh, Daniel McDuff and Rosalind W. Picard

Cardiocam is a low-cost, non-contact technology for measurement of physiological signals such as heart rate and breathing rate using a basic digital imaging device such as a webcam. The ability to perform remote measurements of vital signs is promising for enhancing the delivery of primary health care.

313. CrowdCounsel

Rosalind W. Picard and Robert Morris

Efforts to build emotionally responsive forms of artificial intelligence have been hampered by many difficulties, not least of which include the challenges of natural language processing. Although there have been many gains in this domain, it is still difficult to build technologies that offer nuanced forms of emotional support. To address these challenges, researchers might look towards human computation – an approach that harnesses the power of large, distributed online communities to solve artificial intelligence problems that might otherwise be intractable. We present a new technological approach that uses human computation algorithms, in conjunction with on-demand online workforces, to provide expedient emotional support.

314. Customized Computer-Mediated Interventions

Rosalind W. Picard and Rob Morris

Individuals diagnosed with autism spectrum disorder (ASD) often have intense, focused interests. These interests, when harnessed properly, can help motivate an individual to persist in a task that might otherwise be too challenging or bothersome. For example, past research has shown that embedding focused interests into educational curricula can increase task adherence and task performance in individuals with ASD. However, providing this degree of customization is often time-consuming and costly and, in the case of computer-mediated interventions, high-level computer-programming skills are often required. We have recently designed new software to solve this problem. Specifically, we have built an algorithm that will: (1) retrieve user-specified images from the Google database; (2) strip them of their background; and (3) embed them seamlessly into Flash-based computer programs.

315. Emotion and Memory

Daniel McDuff, Rana el Kaliouby and Rosalind Picard

NEW LISTING

Have you ever wondered what makes an ad memorable? We have performed a comprehensive review of literature concerning advertising, memory, and emotion. A summary of results are available.

316. Emotional-Social Intelligence Toolkit

Rosalind W. Picard, Rana el Kaliouby, Matthew Goodwin, Mish Madsen, Micah Eckhardt and M. Ehsan Hoque

Social-emotional communication difficulties lie at the core of autism spectrum disorders, making interpersonal interactions overwhelming, frustrating, and stressful. We are developing the world's first wearable affective technologies to help the growing number of individuals diagnosed with autism—approximately 1 in 150 children in the United States—learn about nonverbal communication in a natural, social context. We are also developing technologies that build on the nonverbal communication that individuals are already using to express themselves, to help families, educators, and other persons who deal with autism spectrum disorders to better understand these alternative means of nonverbal communication.

Alumni Contributor: Alea Teeters

317. Evaluation Tool for Recognition of Social-Emotional Expressions from Facial-Head Movements

Rosalind W. Picard

To help people improve their reading of faces during natural conversations, we developed a video tool to evaluate this skill. We collected over 100 videos of conversations between pairs of both autistic and neurotypical people, each wearing a Self-Cam. The videos were manually segmented into chunks of 7-20 seconds according to expressive content, labeled, and sorted by difficulty—all tasks we plan to automate using technologies under development. Next, we built a rating interface including videos of self, peers, familiar adults, strangers, and unknown actors, allowing for performance comparisons across conditions of familiarity and expression. We obtained reliable identification (by coders) of categories of smiling, happy, interested, thinking, and unsure in the segmented videos. The tool was finally used to assess recognition of these five categories for eight neurotypical and five autistic people. Results show some autistics approaching the abilities of neurotypicals while several score just above random.

Alumni Contributor: Alea Teeters

318. Exploring Temporal Patterns of Smile

Rosalind W. Picard and Mohammed Ehasanul Hoque

A smile is a multi-purpose expression. We smile to express rapport, polite disagreement, delight, sarcasm, and often, even frustration. Is it possible to develop computational models to distinguish among smiling instances when delighted, frustrated or just being polite? In our ongoing work, we demonstrate that it is useful to explore how the patterns of smile evolve through time, and that while a smile may occur in positive and in negative situations, its dynamics may help to disambiguate the underlying state.

319. Externalization Toolkit

Rosalind W. Picard, Matthew Goodwin and Jackie Chia-Hsun Lee

We propose a set of customizable, easy-to-understand, and low-cost physiological toolkits in order to enable people to visualize and utilize autonomic arousal information. In particular, we aim for the toolkits to be usable in one of the most challenging usability conditions: helping individuals diagnosed with autism. This toolkit includes: wearable, wireless, heart-rate and skin-conductance sensors; pendant-like and hand-held physiological indicators hidden or embedded into certain toys or tools; and a customized software interface that allows caregivers and parents to establish a general understanding of an individual's arousal profile from daily life and to set up physiological alarms for events of interest. We are evaluating the ability of this externalization toolkit to help individuals on the autism spectrum to better communicate their internal states to trusted teachers and family members.

320. FaceSense: Affective-Cognitive State Inference from Facial Video

Daniel McDuff, Rana el Kaliouby, Abdelrahman Nasser Mahmoud, Youssef Kashef, M. Ehsan Hoque, Matthew Goodwin and Rosalind W. Picard

People express and communicate their mental states—such as emotions, thoughts, and desires—through facial expressions, vocal nuances, gestures, and other non-verbal channels. We have developed a computational model that enables real-time analysis, tagging, and inference of cognitive-affective mental states from facial video. This framework combines bottom-up, vision-based processing of the face (e.g., a head nod or smile) with top-down predictions of mental-state models (e.g., interest and confusion) to interpret the meaning underlying head and facial signals over time. Our system tags facial expressions, head gestures, and affective-cognitive states at multiple spatial and temporal granularities in real time and offline, in both natural human-human and human-computer interaction contexts. A version of this system is being made available commercially by Media Lab spin-off Affectiva, indexing emotion from faces. Applications range from measuring people's experiences to a training tool for autism spectrum disorders and people who are nonverbal learning disabled.

Alumni Contributor: Miriam A Madsen

321. Facial Expression Analysis Over the Web

Rosalind W. Picard, Rana el Kaliouby, Daniel Jonathan McDuff, Affectiva and Forbes

We present the first project analyzing facial expressions over the internet. The interface analyzes the participants' smile intensity as they watch popular commercials. They can compare their responses to an aggregate from the larger population. The system also allows us to crowd-source data for training expression recognition systems.

322. FEEL: Frequent EDA Event Logger

Yadid Ayzenberg and Rosalind Picard

Have you ever wondered which emails, phone calls, or meetings cause you the most stress or anxiousness? Well, now you can find out. A wristband sensor measures electrodermal activity (EDA), which responds to stress, anxiety, and arousal. Each time you read an email, place a call, or hold a meeting, your phone will measure your EDA levels by connecting to the sensor via Bluetooth. The goal is to design a tool that enables the user to attribute levels of stress and anxiety to particular events. FEEL allows the user to view all of the events and the levels of EDA that are

associated with them: with FEEL, users can see which event caused a higher level of anxiety and stress, and can view which part of an event caused the greatest reaction. Users can also view EDA levels in real time.

323. Frame It

Rosalind W. Picard and Micah Eckhardt

Frame It is an interactive, blended, tangible-digital puzzle game intended as a play-centered teaching and therapeutic tool. Current work is focused on the development of a social-signals puzzle game for children with autism that will help them recognize social-emotional cues from information surrounding the eyes. In addition, we are investigating if this play-centered therapy results in the children becoming less averse to direct eye contact with others. The study uses eye-tracking technology to measure gaze behavior while participants are exposed to images and videos of social settings and expressions. Results indicate that significant changes in expression recognition and social gaze are possible after repeated uses of the Frame It game platform.

324. Gesture Guitar

Rosalind W. Picard, Rob Morris and Tod Machover

Emotions are often conveyed through gesture. Instruments that respond to gestures offer musicians new, exciting modes of musical expression. This project gives musicians wireless, gestural-based control over guitar effects parameters.

325. IDA: Inexpensive Networked Digital Stethoscope

Yadid Ayzenberg

Complex and expensive medical devices are mainly used in medical facilities by health professionals. IDA is an attempt to disrupt this paradigm and introduce a new type of device: easy to use, low cost, and open source. It is a digital stethoscope that can be connected to the Internet for streaming the physiological data to remote clinicians. Designed to be fabricated anywhere in the world with minimal equipment, it can be operated by individuals without medical training.

326. Infant Monitoring and Communication

Rana el Kaliouby, Rich Fletcher, Matthew Goodwin and Rosalind W. Picard

We have been developing comfortable, safe, attractive physiological sensors that infants can wear around the clock to wirelessly communicate their internal physiological state changes. The sensors capture sympathetic nervous system arousal, temperature, physical activity, and other physiological indications that can be processed to signal changes in sleep, arousal, discomfort or distress, all of which are important for helping parents better understand the internal state of their child and what things stress or soothe their baby. The technology can also be used to collect physiological and circadian patterns of data in infants at risk for developmental disabilities.

327. Long-Term Physio and Behavioral Data Analysis

NEW LISTING

Akane Sano and Rosalind Picard

Most of the time, healthy people feel fine, but sometimes they are tired or have colds. We all have fluctuations of our physical and mental health, but how can we predict the condition of the next step and how can we leverage data from the healthy population to prevent disease? We analyze long-term multi-modal data (electro-dermal activity, skin temperature, and accelerometer) during day and night with wearable sensors to extract bio-markers related to health conditions, interpret inter-individual differences, and develop systems to keep people healthy.

328. Machine Learning and Pattern Recognition with Multiple Modalities

Hyungil Ahn and Rosalind W. Picard

This project develops new theory and algorithms to enable computers to make rapid and accurate inferences from multiple modes of data, such as determining a person's affective state from multiple sensors—video, mouse behavior, chair pressure patterns, typed selections, or physiology. Recent efforts focus on understanding the level of a person's attention, useful for things such as determining when to interrupt. Our approach is Bayesian: formulating probabilistic models on the basis of domain knowledge and training data, and then performing inference according to the rules of probability theory. This type of sensor fusion work is especially challenging due to problems of sensor channel drop-out, different kinds of noise in different channels, dependence between channels, scarce and sometimes inaccurate labels, and patterns to detect that are inherently time-varying. We have constructed a variety of new algorithms for solving these problems and demonstrated their performance gains over other state-of-the-art methods.

Alumni Contributor: Ashish Kapoor

329. Measuring Arousal During Therapy for Children with Autism and ADHD

Rosalind W. Picard and Elliott Hedman

Physiological arousal is an important part of occupational therapy for children with autism and ADHD, but therapists do not have a way to objectively measure how therapy affects arousal. We hypothesize that when children participate in guided activities within an occupational therapy setting, informative changes in electrodermal activity (EDA) can be detected using iCalm. iCalm is a small, wireless sensor that measures EDA and motion, worn on the wrist or above the ankle. Statistical analysis describing how equipment affects EDA was inconclusive, suggesting that many factors play a role in how a child's EDA changes. Case studies provided examples of how occupational therapy affected children's EDA. This is the first study of the effects of occupational therapy's in situ activities using continuous physiologic measures. The results suggest that careful case study analyses of the relation between therapeutic activities and physiological arousal may inform clinical practice.

330. Measuring Customer Experiences with Arousal

Rosalind W. Picard and Elliott Hedman

How can we better understand people's emotional experiences with a product or service? Traditional interview methods require people to remember their emotional state, which is difficult. We use psychophysiological measurements such as heart rate and skin conductance to map people's emotional changes across time. We then interview people about times when their emotions changed, in order to gain insight into the experiences that corresponded with the emotional changes. This method has been used to generate hundreds of insights with a variety of products including games, interfaces, therapeutic activities, and self-driving cars.

331. MIT Mood Meter

Rosalind W. Picard, Javier Hernandez, M. Ehsan Hoque, Will Drevo and Lakshmi Parthasarathy (Harvard)

MIT Mood Meter is designed to assess and display the overall mood of the MIT community, by placing cameras at four different prime spots on the MIT campus (Student Center, Infinite Corridor, Stata Center, and Media Lab). The cameras are equipped with affect-sensing software that counts number of people and whether they are smiling or not. Although smiles are not the only sign of a good mood, in our project, we have used it as a barometer of happiness. This project is intended to raise awareness of how our own smiles can positively affect the surrounding environment, and to assess how congenial MIT is as a community. The dynamic, real-time information may lead to answers to questions such as: Are people from one department happier than others?, Do midterms lower the mood?, or Does warmer weather lead to happiness?"

332. Mobile Health Interventions for Drug Addiction and PTSD

Rich Fletcher and Rosalind Picard

We are developing a mobile phone-based platform to assist people with chronic diseases, panic-anxiety disorders or addictions. Making use of wearable, wireless biosensors, the mobile phone uses pattern analysis and machine learning algorithms to detect specific physiological states and perform automatic interventions in the form of text/images plus sound files and social networking elements. We are currently working with the Veterans Administration drug rehabilitation program involving veterans with PTSD.

333. Multimodal Computational Behavior Analysis

David Forsyth (UIUC), Gregory Abowd (GA Tech), Jim Rehg (GA Tech), Shri Narayanan (USC), Rana el Kaliouby, Matthew Goodwin, Rosalind W. Picard, Javier Hernandez Rivera, Stan Scarloff (BU) and Takeo Kanade (CMU)

This project will define and explore a new research area we call Computational Behavior Science–integrated technologies for multimodal computational sensing and modeling to capture, measure, analyze, and understand human behaviors. Our motivating goal is to revolutionize diagnosis and treatment of behavioral and developmental disorders. Our thesis is that emerging sensing and interpretation capabilities in vision, audition, and wearable computing technologies, when further developed and properly integrated, will transform this vision into reality. More specifically, we hope to: (1) enable widespread autism screening by allowing non-experts to easily collect high-quality behavioral data and perform initial assessment of risk status; (2) improve behavioral therapy through increased availability and improved quality, by making it easier to track the progress of an intervention and follow guidelines for maximizing learning progress; and (3) enable longitudinal analysis of a child's development based on quantitative behavioral data, using new tools for visualization.

334. Sensor-Enabled Measurement of Stereotypy and Arousal in Individuals with Autism

Matthew Goodwin, Clark Freifeld and Sophia Yuditskaya

A small number of studies support the notion of a functional relationship between movement stereotypy and arousal in individuals with ASD, such that changes in autonomic activity either precede or are a consequence of engaging in stereotypical motor movements. Unfortunately, it is difficult to generalize these findings as previous studies fail to report reliability statistics that demonstrate accurate identification of movement stereotypy start and end times, and use autonomic monitors that are obtrusive and thus only suitable for short-term measurement in laboratory settings. The current investigation further explores the relationship between movement stereotypy and autonomic activity in persons with autism by combining state-of-the-art ambulatory heart rate monitors to objectively assess arousal across settings; and wireless, wearable motion sensors and pattern recognition software that can automatically and reliably detect stereotypical motor movements in individuals with autism in real time.

335. Social + Sleep

NEW LISTING

Akane Sano and Rosalind Picard

Sleep is critical to a wide range of biological functions; inadequate sleep results in impaired cognitive performance and mood, and adverse health outcomes including obesity, diabetes, and cardiovascular disease. Recent studies have shown that healthy and unhealthy sleep behaviors can be transmitted by social interactions between individuals within social networks. We investigate how social connectivity and light exposure influence sleep patterns and their health and performance. Using multimodal data collected from closely connected MIT undergraduates with wearable sensors and mobile phones, we will develop the statistical and multi-scale mathematical models of sleep dynamics within social networks based on sleep and circadian physiology. These models will provide insights into the emergent dynamics of sleep behaviors within social networks, and allow us to test the effects of candidate strategies for intervening in populations with unhealthy sleep behaviors.

336. StoryScape

NEW LISTING

Rosalind W. Picard and Micah Eckhardt

StoryScape is a social illustrated primer. The StoryScape platform is being developed to allow for easy creation of highly interactive and customizable stories. In addition, the platform will allow a community of content creators to easily share, collaborate, and remix each others' works. Experimental goals of StoryScape include its use with children diagnosed with autism who are minimally verbal or non-verbal. We seek to test our interaction paradigm and personalization feature to determine if multi-modal interactive and customizable stories influence language acquisition and expression.

337. The Frustration of Learning Monopoly

Rosalind W. Picard and Elliott Hedman

We are looking at the emotional experience created when children learn games. Why do we start games with the most boring part, reading directions? How can we create a product that does not create an abundance of work for parents? Key insights generated from field work, interviews, and measurement of electrodermal activity are: kids become bored listening to directions, "it's like going to school"; parents feel rushed reading directions as they sense their children's boredom; children and parents struggle for power in interpreting and enforcing rules; children learn games by mimicking their parents, and; children enjoy the challenge of learning new games.

Ramesh Raskar—Camera Culture

How to create new ways to capture and share visual information.

338. 6D Display

Ramesh Raskar, Martin Fuchs, Hans-Peter Seidel, and Hendrik P. A. Lensch

Is it possible to create passive displays that respond to changes in viewpoint and incident light conditions? Holograms and 4D displays respond to changes in viewpoint. 6D displays respond to changes in viewpoint as well as surrounding light. We encode the 6D reflectance field into an ordinary 2D film. These displays are completely passive and do not require any power. Applications include novel instruction manuals and mood lights.

339. Bokode: Imperceptible Visual Tags for Camera-Based Interaction from a Distance

Ramesh Raskar, Ankit Mohan, Grace Woo, Shinsaku Hiura and Quinn Smithwick

With over a billion people carrying camera-phones worldwide, we have a new opportunity to upgrade the classic bar code to encourage a flexible interface between the machine world and the human world. Current bar codes must be read within a short range and the codes occupy valuable space on products. We present a new, low-cost, passive optical design so that bar codes can be shrunk to fewer than 3mm and can be read by unmodified ordinary cameras several meters away.

340. CATRA: Mapping of Cataract Opacities Through an Interactive Approach

Ramesh Raskar, Vitor Pamplona, Erick Passos, Jan Zizka, Jason Boggess, David Schafran, Manuel M. Oliveira, Everett Lawson, and Estebam Clua

We introduce a novel interactive method to assess cataracts in the human eye by crafting an optical solution that measures the perceptual impact of forward scattering on the foveal region. Current solutions rely on highly trained clinicians to check the back scattering in the crystallin lens and test their predictions on visual acuity tests. Close-range parallax barriers create collimated beams of light to scan through sub-apertures scattering light as it strikes a cataract. User feedback generates maps for opacity, attenuation, contrast, and local point-spread functions. The goal is to allow a general audience to operate a portable, high-contrast, light-field display to gain a meaningful understanding of their own visual conditions. The compiled maps are used to reconstruct the cataract-affected view of an individual, offering a unique approach for capturing information for screening, diagnostic, and clinical analysis.

341. Coded Computational Photography

Jaewon Kim, Ahmed Kirmani, Ankit Mohan and Ramesh Raskar

Computational photography is an emerging multi-disciplinary field that is at the intersection of optics, signal processing, computer graphics and vision, electronics, art, and online sharing in social networks. The first phase of computational photography was about building a super-camera that has enhanced performance in terms of the traditional parameters, such as dynamic range, field of view, or depth of field. We call this 'Epsilon Photography.' The next phase of computational photography is building tools that go beyond the capabilities of this super-camera. We call this 'Coded Photography.' We can code exposure, aperture, motion, wavelength, and illumination. By blocking light over time or space, we can preserve more details about the scene in the recorded single photograph.

342. Compressive Sensing for Visual Signals

Ramesh Raskar, Kshitij Marwah and Ashok Veeraraghavan (MERL)

Research in computer vision is riding a new tide called compressive sensing. Carefully designed capture methods exploit the sparsity of the underlying signal in a transformed domain to reduce the number of measurements and use an appropriate reconstruction method. Traditional progressive methods capture successively more detail using sequence of simple projection basis whereas random projections do not use any sequence except l0 minimization for reconstruction which is computationally in-efficient. Here, we question this new tide and claim for most situations simple methods work better and the best projective method would be in between the two extremes.

Alumni Contributor: Rohit Pandharkar

343. Layered 3D: Glasses-Free 3D Printing

Gordon Wetzstein, Douglas Lanman, Matthew Hirsch, Wolfgang Heidrich, and Ramesh Raskar

We develop tomographic techniques for image synthesis on displays composed of compact volumes of light-attenuating material. Such volumetric attenuators recreate a 4D light field or high-contrast 2D image when illuminated by a uniform backlight. Since arbitrary views may be inconsistent with any single attenuator, iterative tomographic reconstruction minimizes the difference between the emitted and target light fields, subject to physical constraints on attenuation. For 3D displays, spatial resolution, depth of field, and brightness are increased, compared to parallax barriers. We conclude by demonstrating the benefits and limitations of attenuation-based light field displays using an inexpensive fabrication method: separating multiple printed transparencies with acrylic sheets.

344. LensChat: Sharing Photos with Strangers

Ramesh Raskar, Rob Gens and Wei-Chao Chen

With networked cameras in everyone's pockets, we are exploring the practical and creative possibilities of public imaging. LensChat allows cameras to communicate with each other using trusted optical communications, allowing users to share photos with a friend by taking pictures of each other, or borrow the perspective and abilities of many cameras.

345. Looking Around Corners

Ramesh Raskar, Andrew Bardagjy, Otkrist Gupta, Andreas Velten, Di Wu, and Moungi Bawendi

Using a femtosecond laser and a camera with a time resolution of about one trillion frames per second, we can capture movies of light as it moves through a scene, gets trapped inside a tomato, or bounces off the surfaces in a bottle of water. We use this ability to see the time of flight and to reconstruct images of objects that our camera can not see directly (i.e., to look around the corner).

346. NETRA: Smartphone Add-On for Eye Tests

Vitor Pamplona, Manuel Oliveira, Erick Passos, Ankit Mohan, David Schafran, Jason Boggess and Ramesh Raskar

Can a person look at a portable display, click on a few buttons, and recover his refractive condition? Our optometry solution combines inexpensive optical elements and interactive software components to create a new optometry device suitable for developing countries. The technology allows for early, extremely low-cost, mobile, fast, and automated diagnosis of the most common refractive eye disorders: myopia (nearsightedness), hypermetropia (farsightedness), astigmatism, and presbyopia (age-related visual impairment). The patient overlaps lines in up to eight meridians and the Android app computes the prescription. The average accuracy is comparable to the prior art—and in some cases, even better. We propose the use of our technology as a self-evaluation tool for use in homes, schools, and at health centers in developing countries, and in places where an optometrist is not available or is too expensive.

347. PhotoCloud: Personal to Shared Moments with Angled Graphs of Pictures

NEW LISTING

Ramesh Raskar, Aydin Arpa and Otkrist Gupta

We present a near real-time system for interactively exploring a collectively captured moment without explicit 3D reconstruction. Our system favors immediacy and local coherency to global consistency. It is common to represent photos as vertices of a weighted graph. The weighted angled graphs of photos used in this work can be regarded as the result of discretizing the Riemannian geometry of the high dimensional manifold of all possible photos. Ultimately, our system enables everyday people to take advantage of each others' perspectives in order to create on-the-spot spatiotemporal visual experiences similar to the popular bullet-time sequence. We believe that this type of application will greatly enhance shared human experiences spanning from events as personal as parents watching their children's football game to highly publicized red carpet galas.

348. Polarization Fields: Glasses-Free 3DTV

Douglas Lanman, Gordon Wetzstein, Matthew Hirsch, Wolfgang Heidrich, and Ramesh Raskar

We introduce polarization field displays as an optically efficient design for dynamic light field display using multi-layered LCDs. Such displays consist of a stacked set of liquid crystal panels with a single pair of crossed linear polarizers. Each layer is modeled as a spatially controllable polarization rotator, as opposed to a conventional spatial light modulator that directly attenuates light. We demonstrate that such displays can be controlled, at interactive refresh rates, by adopting the SART algorithm to tomographically solve for the optimal spatially varying polarization state rotations applied by each layer. We validate our design by constructing a prototype using modified off- the-shelf panels. We demonstrate interactive display using a GPU-based SART implementation supporting both polarization-based and attenuation-based architectures.

349. Portable Retinal Imaging

NEW LISTING

Everett Lawson, Jason Boggess, Alex Olwal, Gordon Wetzstein, and Siddharth Khullar

The major challenge in preventing blindness is identifying patients and bringing them to specialty care. Diseases that affect the retina, the image sensor in the human eye, are particularly challenging to address, because they require highly trained eye specialists (ophthalmologists) who use expensive equipment to visualize the inner parts of the eye. Diabetic retinopathy, HIV/AIDS related retinitis, and age-related macular degeneration are three conditions that can be screened and diagnosed to prevent blindness caused by damage to retina. We exploit a combination of two novel ideas which simplify the constraints of traditional devices, with simplified optics and cleaver illumination in order to capture and visualize images of the retina in a standalone device easily operated by the user. Prototypes are conveniently embedded in either a mobile hand-held retinal camera, or wearable eye-glasses.

350. Reflectance Acquisition Using Ultrafast Imaging

Ramesh Raskar and Nikhil Naik

We demonstrate a new technique that allows a camera to rapidly acquire reflectance properties of objects 'in the wild' from a single viewpoint, over relatively long distances and without encircling equipment. This project has a wide variety of applications in computer graphics including image relighting, material identification, and image editing.

351. Second Skin: Motion Capture with Actuated Feedback for Motor Learning

Ramesh Raskar, Kenichiro Fukushi, Christopher Schonauer and Jan Zizka

We have created a 3D motion-tracking system with an automatic, real-time vibrotactile feedback with an assembly of photo-sensors, infrared projector pairs, vibration motors, and wearable suit. This system allows us to enhance and quicken the motor learning process in variety of fields such as healthcare (physiotherapy), entertainment (dance), and sports (martial arts).

Alumni Contributor: Dennis Ryan Miaw

352. Shield Field Imaging

Jaewon Kim

We present a new method for scanning 3D objects in a single shot, shadow-based method. We decouple 3D occluders from 4D illumination using shield fields: the 4D attenuation function which acts on any light field incident on an occluder. We then analyze occluder reconstruction from cast shadows, leading to a single-shot light field camera for visual hull reconstruction.

353. Single Lens Off-Chip Cellphone Microscopy

NEW LISTING

Ramesh Raskar and Aydin Arpa

Within the last few years, cellphone subscriptions have widely spread and now cover even the remotest parts of the planet. Adequate access to healthcare, however, is not widely available, especially in developing countries. We propose a new approach to converting cellphones into low-cost scientific devices for microscopy. Cellphone microscopes have the potential to revolutionize health-related screening and analysis for a variety of applications, including blood and water tests. Our optical system is more flexible than previously proposed mobile microscopes, and allows for wide field of view panoramic imaging, the acquisition of parallax, and coded background illumination, which optically enhances the contrast of transparent and refractive specimens.

354. Slow Display

Daniel Saakes, Kevin Chiu, Tyler Hutchison, Biyeun Buczyk, Naoya Koizumi and Masahiko Inami

How can we show our 16 megapixel photos from our latest trip on a digital display? How can we create screens that are visible in direct sunlight as well as complete darkness? How can we create large displays that consume less than 2W of power? How can we create design tools for digital decal application and intuitive-computer aided modeling? We introduce a display that is high resolution but updates at a low frame rate, a slow display. We use lasers and monostable light-reactive materials to provide programmable space-time resolution. This refreshable, high resolution display exploits the time decay of monostable materials, making it attractive in terms of cost and power requirements. Our effort to repurpose these materials involves solving underlying problems in color reproduction, day- night visibility, and optimal time sequences for updating content.

355. Soundaround

Henry Holtzman, Ramesh Raskar, Matt Hirsch, Alex Olwal and Thomas A. Baran

Recently, multi-view display hardware has made compelling progress in graphics. Soundaround is a multi-viewer interactive audio system, designed to be integrated into unencumbered multi-view display systems, presenting localized audio/video channels with no need for glasses or headphones. Our technical work describes a framework for the design of multi-viewer interactive audio systems that is general and supports optimization of the system for multiple observation planes and room responses.

356. SpeckleSense

Alex Olwal, Andrew Bardagjy, Jan Zizka and Ramesh Raskar

Motion sensing is of fundamental importance for user interfaces and input devices. In applications where optical sensing is preferred, traditional camera-based approaches can be prohibitive due to limited resolution, low frame rates, and the required computational power for image processing. We introduce a novel set of motion-sensing configurations based on laser speckle sensing that are particularly suitable for human-computer interaction. The underlying principles allow these configurations to be fast, precise, extremely compact, and low cost.

357. Tensor Displays: High-Quality Glasses-Free 3D TV

NEW LISTING

Gordon Wetzstein, Douglas Lanman, Matthew Hirsch and Ramesh Raskar

We introduce tensor displays: a family of glasses-free 3D displays comprising all architectures employing (a stack of) time-multiplexed LCDs illuminated by uniform or directional backlighting. We introduce a unified optimization framework that encompasses all tensor display architectures and allows for optimal glasses-free 3D display. We demonstrate the benefits of tensor displays by constructing a reconfigurable prototype using modified LCD panels and a custom integral imaging backlight. Our efficient, GPU-based NTF implementation enables interactive applications. In our experiments we show that tensor displays reveal practical architectures with greater depths of field, wider fields of view, and thinner form factors, compared to prior automultiscopic displays.

358. Theory Unifying Ray and Wavefront Lightfield Propagation

George Barbastathis, Ramesh Raskar, Belen Masia, Se Baek Oh and Tom Cuypers

This work focuses on bringing powerful concepts from wave optics to the creation of new algorithms and applications for computer vision and graphics. Specifically, ray-based, 4D lightfield representation, based on simple 3D geometric principles, has led to a range of new applications that include digital refocusing, depth estimation, synthetic aperture, and glare reduction within a camera or using an array of cameras. The lightfield representation, however, is inadequate to describe interactions with diffractive or phase-sensitive optical elements. Therefore we use Fourier optics principles to represent wavefronts with additional phase information. We introduce a key modification to the ray-based model to support modeling of wave phenomena. The two key ideas are "negative radiance" and a "virtual light projector." This involves exploiting higher dimensional representation of light transport.

359. Trillion Frames Per Second Camera

Ramesh Raskar, Andreas Velten, Everett Lawson, Di Wu, and Moungi G. Bawendi

We have developed a camera system that captures movies at an effective rate of approximately one trillion frames per second. In one frame of our movie, light moves only about 0.6 mm. We can observe pulses of light as they propagate through a scene. We use this information to understand how light propagation affects image formation and to learn things about a scene that are invisible to a regular camera.

360. Vision on Tap

Ramesh Raskar

Computer vision is a class of technologies that lets computers use cameras to automatically stitch together panoramas, reconstruct 3-D geometry from multiple photographs, and even tell you when the water's boiling. For decades, this technology has been advancing mostly within the confines of academic institutions and research labs. Vision on Tap is our attempt to bring computer vision to the masses.

Alumni Contributor: Kevin Chiu

361. VisionBlocks

Abhijit Bendale, Kshitij Marwah and Jason R Boggess

VisionBlocks is an on-demand, in-browser, customizable, computer-vision application-building platform for the masses. Even without any prior programming experience, users can create and share computer vision applications. End-users drag and drop computer vision processing blocks to create their apps. The input feed could be either from a user's webcam or a video from the Internet. VisionBlocks is a community effort where researchers obtain fast feedback, developers monetize their vision applications, and consumers can use state-of-the-art computer vision techniques. We envision a Vision-as-a-Service (VaaS) over-the-web model, with easy-to-use interfaces for application creation for everyone.

Alumni Contributor: Kevin Chiu

Mitchel Resnick—Lifelong Kindergarten

How to engage people in creative learning experiences.

362. Collab Camp

Ricarose Roque, Amos Blanton, Natalie Rusk and Mitchel Resnick

To foster and better understand collaboration in the Scratch Online Community, we created Collab Camp, a month-long event in which Scratch community members form teams (“collabs”) to work together on Scratch projects. Our goals include: analyzing how different organizational structures support collaboration in different ways; examining how design decisions influence the diversity of participation in collaborative activities; and studying the role of constructive feedback in creative, collaborative processes.

363. Color Code

Jay Silver, Eric Rosenbaum, and Mitchel Resnick

With Color Code, you can create computer programs that respond to colors of objects in the physical world. You can stack up LEGO bricks to form an obstacle in a video game, integrate a crayon-drawn picture into a virtual story, or use M&Ms to create a musical score.

364. Computer Clubhouse

Mitchel Resnick, Natalie Rusk, Chris Garrity, Claudia Urrea, Amon Millner, and Robbie Berg

At Computer Clubhouse after-school centers, young people (ages 10-18) from low-income communities learn to express themselves creatively with new technologies. Clubhouse members work on projects based on their own interests, with support from adult mentors. By creating their own animations, interactive stories, music videos, and robotic constructions, Clubhouse members become more capable, confident, and creative learners. The first Computer Clubhouse was established in 1993, as a collaboration between the Lifelong Kindergarten group and The Computer Museum (now part of the Boston Museum of Science). With financial support from Intel Corporation, the network has expanded to more than 20 countries, serving more than 20,000 young people. The Lifelong Kindergarten group continues to develop new technologies, introduce new educational approaches, and lead professional-development workshops for Clubhouses around the world.

Alumni Contributors: Leo Burd, Robbin Chapman, Rachel Garber, Tim Gorton, Michelle Hlubinka and Elisabeth Sylvan

365. Computer Clubhouse Village

Chris Garrity, Natalie Rusk and Mitchel Resnick

The Computer Clubhouse Village is an online community that connects people at Computer Clubhouse after-school centers around the world. Through the Village, Clubhouse members and staff (at more than 100 Clubhouses in 21 countries) can share ideas with one another, get feedback and advice on their projects, and work together on collaborative design activities.

Alumni Contributors: Robbin Chapman, Rachel Garber and Elisabeth Sylvan

366. Drawdio

Jay Silver and Mitchel Resnick

Drawdio is a pencil that draws music. You can sketch musical instruments on paper and play them with your finger. Touch your drawings to bring them to life—or collaborate through skin-to-skin contact. Drawdio works by creating electrical circuits with graphite and the human body.

367. Learning with Data

Sayamindu Dasgupta and Mitchel Resnick

More and more computational activities revolve around collecting, accessing, and manipulating large sets of data, but introductory approaches for learning programming typically are centered around algorithmic concepts and flow of control, not around data. Computational exploration of data, especially data-sets, has been usually restricted to predefined operations in spreadsheet software like Microsoft Excel. This project builds on the Scratch programming language and environment to allow children to explore data and datasets. With the extensions provided by this project, children can build Scratch programs to not only manipulate and analyze data from online sources, but also to collect data through various means such as surveys and crowd-sourcing. This toolkit will support many different types of projects like online polls, turn-based multiplayer games, crowd-sourced stories, visualizations, information widgets, and quiz-type games.

368. MaKey MaKey

Eric Rosenbaum, Jay Silver, and Mitchel Resnick

NEW LISTING

MaKey MaKey lets you transform everyday objects into computer interfaces. Make a game pad out of Play-Doh, a musical instrument out of bananas, or any other invention you can imagine. It's a little USB device you plug into your computer and you use it to make your own switches that act like keys on the keyboard: Make + Key = MaKey MaKey! It’s plug and play. No need for any electronics or programming skills. Since MaKey MaKey looks to your computer like a regular mouse and keyboard, it’s automatically compatible with any piece of software you can think of. It’s great for beginners tinkering and exploring, for experts prototyping and inventing, and for everybody who wants to playfully transform their world.

369. MelodyMorph

Eric Rosenbaum and Mitchel Resnick

MelodyMorph is an interface for constructing melodies and making improvised music. It removes a constraint of traditional musical instruments: a fixed mapping between space and pitch. What if you blew up the piano so you could put the keys anywhere you want? With MelodyMorph you can create a customized musical instrument, unique to the piece of music, the player, or the moment.

370. Re·play

Tiffany Tseng, Robert Hemsley, and Mitchel Resnick

NEW LISTING

Re•play is a self-documenting construction kit for children both to share their designs with others and reflect on their own design process. Re•play consists of a set of angular construction pieces that can sense their connection and orientation. A virtual model is rendered in real time as a design is constructed, and an on-screen playback interface allows users to view models from multiple perspectives and watch how a design was assembled.

371. Scratch

Mitchel Resnick, John Maloney, Natalie Rusk, Karen Brennan, Champika Fernanda, Ricarose Roque, Sayamindu Dasgupta, Amos Blanton, Andres Monroy-Hernandez, Eric Rosenbaum, Jay Silver, Michelle Chung, Gaia Carini, Tony Hwang, Claudia Urrea, Brian Silverman,

Scratch is a programming language and online community (http://scratch.mit.edu) that makes it easy to create your own interactive stories, games, animations, and simulations—and share your creations online. As young people create and share Scratch projects, they learn to think creatively, reason systematically, and work collaborative, while also learning important mathematical and computational ideas. More than 2 million projects have been shared on the Scratch website. We are currently working on a next generation of Scratch, called Scratch 2.0, to be launched in 2012.

Alumni Contributors: Margarita Dekoli, Evelyn Eastmond, Amon Millner and Tamara Stern

372. Scratch Day

Karen Brennan and Mitchel Resnick

Scratch Day is a network of face-to-face local gatherings, on the same day in all parts of the world, where people can meet, share, and learn more about Scratch, a programming environment that enables people to create their own interactive stories, games, animations, and simulations. We believe that these types of face-to-face interactions remain essential for ensuring the accessibility and sustainability of initiatives such as Scratch. In-person interactions enable richer forms of communication among individuals, more rapid iteration of ideas, and a deeper sense of belonging and participation in a community. The first Scratch Day took place on May 16, 2009, with 120 events in 44 different countries. The second Scratch Day took place on May 22, 2010.

373. ScratchEd

Karen Brennan, Michelle Chung, and Mitchel Resnick

As Scratch proliferates through the world, there is a growing need to support learners. But for teachers, educators, and others who are primarily concerned with enabling Scratch learning, there is a disconnect between their needs and the resources that are presently available through the Scratch Web site. ScratchEd is an online environment for Scratch educators to share stories, exchange resources, ask questions, and find people.

374. ScratchJr

Mitchel Resnick, Marina Bers, Paula Bonta, Brian Silverman and Sayamindu Dasgupta

NEW LISTING

The ScratchJr project aims to bring the ideas and spirit of Scratch programming activities to younger children, enabling children ages five to seven to program their own interactive stories, games, and animation. To make ScratchJr developmentally appropriate for younger children, we are revising the interface and providing new structures to help young children learn core math concepts and problem-solving strategies. We hope to make a version of ScratchJr publicly available in 2013.

375. Singing Fingers

Eric Rosenbaum, Jay Silver and Mitchel Resnick

Singing Fingers allows children to fingerpaint with sound. Users paint by touching a screen with a finger, but color only emerges if a sound is made at the same time. By touching the painting again, users can play back the sound. This creates a new level of accessibility for recording, playback, and remixing of sound.

376. Watch Me Move!

Ting-Hsiang Tony Hwang

NEW LISTING

Microsoft Kinect has popularized the use of body gestures to control games and animations, but only expert programmers can create applications for the Kinect. With our new video-motion extensions to Scratch, it is possible for everyone, even novice programmers, to create Kinect-like games and animations using only a standard webcam. Our extension uses computer-vision algorithms based on optical flow to track motion from real-time video, allowing Scratch programmers to access the amount and direction of motion across the whole scene and also under individual objects.

Deb Roy—Cognitive Machines

How to build machines that learn to use language in human-like ways, and develop tools and models to better understand how children learn to communicate and how adults behave.

377. BlitzScribe: Speech Analysis for the Human Speechome Project

Brandon Roy and Deb Roy

BlitzScribe is a new approach to speech transcription driven by the demands of today's massive multimedia corpora. High-quality annotations are essential for indexing and analyzing many multimedia datasets; in particular, our study of language development for the Human Speechome Project depends on speech transcripts. Unfortunately, automatic speech transcription is inadequate for many natural speech recordings, and traditional approaches to manual transcription are extremely labor intensive and expensive. BlitzScribe uses a semi-automatic approach, combining human and machine effort to dramatically improve transcription speed. Automatic methods identify and segment speech in dense, multitrack audio recordings, allowing us to build streamlined user interfaces maximizing human productivity. The first version of BlitzScribe is already about 4-6 times faster than existing systems. We are exploring user-interface design, machine-learning and pattern-recognition techniques to build a human-machine collaborative system that will make massive transcription tasks feasible and affordable.

378. Crowdsourcing the Creation of Smart Role-Playing Agents

Jeff Orkin and Deb Roy

We are crowdsourcing the creation of socially rich interactive characters by collecting data from thousands of people interacting and conversing in online multiplayer games, and mining recorded gameplay to extract patterns in language and behavior. The tools and algorithms we are developing allow non-experts to automate characters who can play roles by interacting and conversing with humans (via speech or typed text), and with each other. The Restaurant Game recorded over 16,000 people playing the roles of customers and waitresses in a virtual restaurant. Improviso is recording humans playing the roles of actors on the set of a sci-fi movie. This approach will enable new forms of interaction for games, training simulations, customer service, and HR job applicant screening systems.

379. HouseFly: Immersive Video Browsing and Data Visualization

Philip DeCamp, Rony Kubat and Deb Roy

HouseFly combines audio-video recordings from multiple cameras and microphones to generate an interactive, 3D reconstruction of recorded events. Developed for use with the longitudinal recordings collected by the Human Speechome Project, this software enables the user to move freely throughout a virtual model of a home and to play back events at any time or speed. In addition to audio and video, the project explores how different kinds of data may be visualized in a virtual space, including speech transcripts, person tracking data, and retail transactions.

Alumni Contributor: George Shaw

380. Human Speechome Project

Philip DeCamp, Brandon Roy, Soroush Vosoughi and Deb Roy

The Human Speechome Project is an effort to observe and computationally model the longitudinal language development of a single child at an unprecedented scale. To achieve this, we are recording, storing, visualizing, and analyzing communication and behavior patterns in over 200,000 hours of home video and speech recordings. The tools that are being developed for mining and learning from hundreds of terabytes of multimedia data offer the potential for breaking open new business opportunities for a broad range of industries—from security to Internet commerce.

Alumni Contributors: Michael Fleischman, Jethran Guinness, Alexia Salata and George Shaw

381. Speech Interaction Analysis for the Human Speechome Project

Brandon Roy and Deb Roy

The Speechome Corpus is the largest corpus of a single child learning language in a naturalistic setting. We have now transcribed significant amounts of the speech to support new kinds of language analysis. We are currently focusing on the child's lexical development, pinpointing "word births" and relating them to caregiver language use. Our initial results show child vocabulary growth at an unprecedented temporal resolution, as well as a detailed picture of other measures of linguistic development. The results suggest individual caregivers "tune" their spoken interactions to the child's linguistic ability with far more precision than expected, helping to scaffold language development. To perform these analyses, new tools have been developed for interactive data annotation and exploration.

382. Speechome Recorder for the Study of Child Development Disorders

Soroush Vosoughi, Joe Wood, Matthew Goodwin and Deb Roy

Collection and analysis of dense, longitudinal observational data of child behavior in natural, ecologically valid, non-laboratory settings holds significant benefits for advancing the understanding of autism and other developmental disorders. We have developed the Speechome Recorder—a portable version of the embedded audio/video recording technology originally developed for the Human Speechome Project—to facilitate swift, cost-effective deployment in special-needs clinics and homes. Recording child behavior daily in these settings will enable us to study developmental trajectories of autistic children from infancy through early childhood, as well as atypical dynamics of social interaction as they evolve on a day-to-day basis. Its portability makes possible potentially large-scale comparative study of developmental milestones in both neurotypical and autistic children. Data-analysis tools developed in this research aim to reveal new insights toward early detection, provide more accurate assessments of context-specific behaviors for individualized treatment, and shed light on the enduring mysteries of autism.

Alumni Contributors: George Shaw and Philip DeCamp

Chris Schmandt—Speech + Mobility

How speech technologies and portable devices can enhance communication.

383. Back Talk

Chris Schmandt and Andrea Colaco

The living room is the heart of social and communal interactions in a home. Often present in this space is a screen: the television. When in use, this communal gathering space brings together people and their interests, and their varying needs for company, devices, and content. This project focuses on using personal devices such as mobile phones with the television; the phone serves as a controller and social interface by offering a channel to convey engagement, laughter, and viewer comments, and to create remote co-presence.

384. ByConsens.us

Chris Schmandt and Charlie DeTar

Bringing deliberative process and consensus decision making to the 21st century! A practical set of tools for assisting in meeting structure, deliberative process, brainstorming, and negotiation. Helping groups to democratically engage with each other, across geographies and time zones.

385. Dotstorm

Chris Schmandt and Charlie DeTar

NEW LISTING

The "Nominal Group Technique" is a popular way to brainstorm, often executed with Post-it notes and voting stickers. We're reimagining and reimplementing this technique for online use, for things such as hackathons, design workshops, and brainstorms across multiple geographies. The best part: everyone can take the results of the brainstorm with them, and embed it in blogs or websites.

386. Flickr This

Chris Schmandt and Dori Lin

Inspired by the fact that people are communicating more and more through technology, Flickr This explores ways for people to have emotion-rich conversations through all kinds of media provided by people and technology—a way for technology to allow remote people to have conversations more like face-to-face experiences by grounding them in shared media. Flickr This lets viewable contents provide structure for a conversation; with a grounding on the viewable contents, conversation can move between synchronous and asynchronous, and evolve into a richer collaborative conversation/media.

387. frontdesk

Chris Schmandt and Andrea Colaco

Calling a person versus calling a place has quite distinctive affordances. With the arrival of mobile phones, the concept of calling has moved from calling a place to calling a person. Frontdesk proposes a place-based communication tool that is accessed primarily through any mobile device and features voice calls and text chat. The application uses “place” loosely to define a physical space created by a group of people that have a shared context of that place. Examples of places could be different parts of a workspace in a physical building, such as the machine shop, café, or Speech + Mobility group area at the Media Lab. When a user calls any of these places, frontdesk routes their call to all people that are “checked-in” to the place.

388. Going My Way

Chris Schmandt and Jaewoo Chung

When friends give directions, they often don't describe the whole route, but instead provide landmarks along the way which with they think we'll be familiar. Friends can assume we have certain knowledge because they know our likes and dislikes. Going My Way attempts to mimic a friend by learning about where you travel, identifying the areas that are close to the desired destination from your frequent path, and picking a set of landmarks to allow you to choose a familiar one. When you select one of the provided landmarks, Going My Way will provide directions from it to the destination.

Alumni Contributors: Chaochi Chang and Paulina Lisa Modlitba

389. Guiding Light

Chris Schmandt and Jaewoo Chung

Guiding Light is a navigation-based application that provides directions by projecting them onto physical spaces both indoors and outdoors. It enables a user to get relevant spatial information by using a mini projector in a cell phone. The core metaphor involved in this design is that of a flashlight which reveals objects in and information about the space it illuminates. For indoor navigation, Guiding Light uses a combination of e-compass, accelerometer, proximity sensors, and tags to place information appropriately. In contrast to existing heads-up displays that push information into the user's field of view, Guiding Light works on a pull principle, relying entirely on users' requests and control of information.

390. Indoor Location Sensing Using Geo-Magnetism

Chris Schmandt, Jaewoo Chung, Nan-Wei Gong, Wu-Hsi Li and Joe Paradiso

We present an indoor positioning system that measures location using disturbances of the Earth's magnetic field by structural steel elements in a building. The presence of these large steel members warps the geomagnetic field such that lines of magnetic force are locally not parallel. We measure the divergence of the lines of the magnetic force field using e-compass parts with slight physical offsets; these measurements are used to create local position signatures for later comparison with values in the same sensors at a location to be measured. We demonstrate accuracy within one meter 88% of the time in experiments in two buildings and across multiple floors within the buildings.

391. LocoRadio

Chris Schmandt and Wu-Hsi Li

LocoRadio is a mobile, augmented-reality, audio browsing system that immerses you within a soundscape as you move. To enhance the browsing experience in high-density spatialized audio environments, we introduce a UI feature, "auditory spatial scaling," which enables users to continuously adjust the spatial density of perceived sounds. The audio will come from a custom, geo-tagged audio database. The current demo uses iconic music to represent restaurants. As users move in the city, they encounter a series of music and the perception enhances their awareness of the numbers, styles, and locations of nearby restaurants.

392. Merry Miser

Chris Schmandt and Charlie DeTar

Merry Miser is a mobile application which persuades people to spend less money, and think more about their spending. By combining users' real financial transaction information, their location, and personal assessments of spending, the application presents deeply personalized and compelling interventions at the time and place when they are near an opportunity to shop. The interventions help to reinforce choices that are in the users' better long-term self interest, against short-term impulses.

393. Musicpainter

Chris Schmandt, Barry Vercoe and Wu-Hsi Li

Musicpainter is a networked, graphical composing environment that encourages sharing and collaboration within the composing process. It provides a social environment where users can gather and learn from each other. The approach is based on sharing and managing music creation in small and large scales. At the small scale, users are encouraged to begin composing by conceiving small musical ideas, such as melodic or rhythmic fragments, all of which are collected

and made available to all users as a shared composing resource. The collection provides a dynamic source of composing material that is inspiring and reusable. At the large scale, users can access full compositions that are shared as open projects. Users can listen to and change any piece. The system generates an attribution list on the edited piece, allowing users to trace how it evolves in the environment.

394. OnTheRun

Chris Schmandt and Matthew Joseph Donahoe

OnTheRun is a location-based exercise game designed for the iPhone. The player assumes the role of a fugitive trying to gather clues to clear his name. The game is played outdoors while running, and the game creates missions that are tailored to the player's neighborhood and running ability. The game is primarily an audio experience, and gameplay involves following turn-by-turn directions, outrunning virtual enemies, and reaching destinations.

395. Puzzlaef

Chris Schmandt, Sinchan Banerjee, and Drew Harry

How can one understand and visualize the lifestyle of a person on the other side of the world? Puzzlaef attempts to tackle this question through a mobile picture puzzle game where users collaboratively solve with pictures from their lifestyles.

396. Radio-ish Media Player

Chris Schmandt, Barry Vercoe and Wu-Hsi Li

How many decisions does it take before you hear a desired piece of music on your iPod? First, you are asked to pick a genre, then an artist, then an album, and finally a song. The more songs you own, the tougher the choices are. To resolve the issues, we turn the modern music player into an old analog radio tuner, the Radio-ish Media Player. No LCDs, no favorite channels, all you have is a knob that will help you surf through channel after channel accompanied by synthesized noise. Radio-ish is our attempt to revive the lost art of channel surfing in the old analog radio tuner. Let music find you: your ears will tell you if the music is right. This project is not only a retrospective design, but also our reflection on lost simplicity in the process of digitalization. A mobile phone version is also available for demo.

397. ROAR

Chris Schmandt and Drew Harry

The experience of being in a crowd is visceral. We feel a sense of connection and belonging through shared experiences like watching a sporting event, speech, or performance. In online environments, though, we are often part of a crowd without feeling it. ROAR is designed to allow very large groups of distributed spectators have meaningful conversations with strangers or friends while creating a sense of presence of thousands of other spectators. ROAR is also interested in creating opportunities for collective action among spectators and providing flexible ways to share content among very large groups. These systems combine to let you feel the roar of the crowd even if you're alone in your bedroom.

398. SeeIt-ShareIt

Chris Schmandt, Andrea Colaco

Now that mobile phones are starting to have 3D display and capture capabilities, there are opportunities to enable new applications that enhance person-person communication or person-object interaction. This project explores one such application: acquiring 3D models of objects using cell phones with stereo cameras. Such models could serve as shared objects that ground communication in virtual environments and mirrored worlds or in mobile augmented reality applications.

399. Spotz

Chris Schmandt and Misha Sra

Exploring your city is a great way to make friends, discover new places, find new interests, and invent yourself. Tagzz is an Android app where everyone collectively defines the places they visit and the places in turn define them. Tagzz allows you to discover yourself by discovering places. You tag a spot, create some buzz for it and, if everyone agrees the spot is 'fun' this bolsters your 'fun' quotient. If everyone agrees the spot is 'geeky' it pushes up your ‘geeky’ score. Thus emerges your personal tag cloud. Follow tags to chance upon new places. Find people with similar 'tag clouds' as your own and experience new places together. Create buzz for your favorite spots and track other buzz to find who has the #bestchocolatecake in town!

400. Tin Can

Chris Schmandt, Matthew Donahoe and Drew Harry

Distributed meetings present a set of interesting challenges to staying engaged and involved. Because one person speaks at a time, it is easy (particularly for remote participants) to disengage from the meeting undetected. However, non-speaking roles in a meeting can be just as important as speaking ones, and if we could give non-speaking participants ways to participate, we could help support better-run meetings of all kinds. Tin Can collects background tasks like taking notes, managing the agenda, sharing relevant content, and tracking to-dos in a distributed interface that

uses meeting participants' phones and laptops as input devices, and represents current meeting activities on an iPad in the center of the table in each meeting location. By publicly representing these background processes, we provide meeting attendees with new ways to participate and be recognized for their non-verbal participation.

401. Tin Can Classroom

Chris Schmandt, Drew Harry and Eric Gordon (Emerson College)

Classroom discussions may not seem like an environment that needs a new kind of supporting technology. But we've found that augmenting classroom discussions with an iPad-based environment to help promote discussion, keep track of current and future discussion topics, and create a shared record of class keeps students engaged and involved with discussion topics, and helps restart the discussion when conversation lags. Contrary to what you might expect, having another discussion venue doesn't seem to add to student distraction; rather it tends to focus distracted students on this backchannel discussion. For the instructor, our system offers powerful insights into the engagement and interests of students who tend to speak less in class, which in turn can empower less-active students to contribute in a venue in which they feel more comfortable.

Ethan Zuckerman—Civic Media

How to create technical and social systems to allow communities to share, understand, and act on civic information.

402. AAGO: Mobile Media Diaries for Youth Citizens Journalists

Nitin Sawhney, Audubon Dougherty and Rogelio Alejandro Lopez

AAGO is a mobile app for Apple devices focusing on media creation, organization and sharing. Targeted to teens, the app aims to help them document group or individual creative projects (filmmaking, tech or art projects, citizen journalism) by creating "stories" made up of mobile photos, videos, and audio clips, which can then be arranged and exported to the web.

403. Between the Bars

Charlie DeTar

Between the Bars is a blogging platform for one out of every 142 Americans—prisoners—that makes it easy to blog using standard postal mail. It consists of software tools to make it easy to upload PDF scans of letters, crowd-sourced transcriptions of the scanned images. Between the Bars includes the usual full-featured blogging tools including comments, tagging, RSS feeds, and notifications for friends and family when new posts are available.

404. Civic Gardens

Lorrie LeJeune and Ethan Zuckerman

NEW LISTING

Community gardens have many benefits beyond providing a source of nutritious food: they provide a catalyst for community development, encourage cooperation, and stimulate social interaction. Building on those themes, the Civic Gardens project brings sustainable community agriculture to indoor office spaces. In our first phase, we are testing a prototype multicolor LED lighting system on a variety of edible garden plants. Members of the Media Lab community are invited to provide and help care for the plants and then share in their harvest. Phase two will see the addition of a computer-based interface to fine-tune and control the light and water, and construction of an attractive "office friendly" structure to house all the components.

405. Codesign Toolkit

Sasha Costanza-Chock, Molly Sauter

Involving communities in the design process results in a product that is more responsive to a community's needs, more suited to their accessibility and usability concerns, and eases adoption within the target community. Civic media tools, platforms and research work best when practitioners involve target communities at all stages of the process, including iterative ideation, prototyping, testing, and evaluation. In the co-design process, communities act as co-designers and participants, rather than mere consumers, end-users, test subjects or objects of study. Co-design is used in many projects in the Center for Civic Media and the Media Lab at large, including the Aago project, Cronicas de Heroes, SameBoat, Grassroots Mapping, My Dot Tour, and Locast. The Toolkit will enable more designers and researchers to utilize the co-design process in their work by presenting current theory and practices in a comprehensive, accessible manner.

406. Data Therapy

Rahul Bhargava

We are actively engaging with community coalitions in order to build their capacity to do their own data visualization and presentation. New computer-based tools are lowering the barriers of entry for making engaging and creative presentations of data. Rather than encouraging partnerships with epidemiologists, statisticians, or programmers, we see an opportunity to build capacity within small community organizations by using these new tools.

407. Department of Play

Leo Burd

The Department of Play (DoP) is a working group of researchers, students, and community practitioners who share a common passion: designing appropriate technology and methods to empower youth and their communities. In particular, the Department of Play initiative aims to develop an easy-to-use, open-source digital toolkit to foster youth participation, social inclusion and local civic engagement. Among other things, we are implementing a multi-channel neighborhood communication system that combines email, SMS and regular touchtone phones to help young people organize and promote block parties, games, performances and other events in the places where they live.

408. Free City

Ethan Zuckerman and Leo Burd

The Free City project promotes awareness and facilitates access to free and low-cost events, services and opportunities that are locally available. By using the technologies in our What's Up toolkit, we aim to reduce the information gap, foster social connectivity and unleash the learning potential of urban centers, contributing to the development of cities that more educated, sustainable, inclusive and democratic.

409. Media Cloud

Hal Roberts, Ethan Zuckerman and David LaRochelle

Media Cloud is a platform for studying media ecosystems—the relationships between professional and citizen media, between online and offline sources. By tracking millions of stories published online or broadcast via television, the system allows researchers to track the spread of memes, media framings and the tone of coverage of different stories. The platform is open source and open data, designed to be a substrate for a wide range of communications research efforts. Media Cloud is a collaboration between Civic Media and the Berkman Center for Internet and Society at Harvard Law School.

410. MediaMeter

Ethan Zuckerman, Nathan Matias, Matt Stempeck, Rahul Bhargava and Dan Schultz

What's in the newspaper you're reading? And what's left out? Are you getting the coverage of local, international, political, and economic stories you want or need? MediaRDI is an automated system that offers "nutritional information labels" for digital news media. In its first phase, the system provides simple visual summaries of the content of a media product or set of sources. In the second phase, we will introduce a tool that allows users to track what media they encounter over the course of a day or week and compare their consumption with others.

411. NGO 2.0

Jing Wang, Rongting Zhou, Endy Xie, Shi Song

NGO2.0 is a project grown out of the work of MIT's New Media Action Lab. The project recognizes that digital media and Web 2.0 are vital to grassroots NGOs in China. NGOs in China operate under enormous constraints because of their semi-legal status. Grassroots NGOs cannot compete with governmental affiliated NGOs for the attention of mainstream media, which leads to difficulties in acquiring resources and raising awareness of the cause they are promoting. The NGO2.0 Project serves grassroots NGOs in the underdeveloped regions of China, training them to enhance their digital and social media literacy through Web 2.0 workshops. The project also rolls out a crowd map to enable the NGO sector and the Corporate Social Responsibility sector to find out what each sector has accomplished in producing social good.

412. Our Things

Nathan Matias

Every community has shared resources, from the laundry machines in the basement of an apartment building to picnic pavilions in community parks. Our Things is a platform that makes it possible for people to share these resources, minimizing conflict and maximizing a sense of collective ownership. Rather than a scheduling and reservation system, Our Things allows individuals to signal when they're using and finished with resources using a range of interfaces. The system produces rich data communities can use to understand when resources are in use.

413. Same Boat

Regan St. Pierre and Leo Burd

The U.S. banking crisis and economic downturn has led to many people to seek assistance from social service agencies who'd not previously sought assistance. Same Boat lets people who've discovered helpful social services to share their discoveries with others who are in the same boat. Using the technologies in our What's Up toolkit, Same Boat is currently in the process of co-development in Wisconsin Falls, Wisconsin in partnership with the Community Foundation of South Wood County, Wisconsin.

414. Social Mirror

Ethan Zuckerman, Nathan Matias, Gaia Marcus and Royal Society of Arts

NEW LISTING

Social Mirror transforms social science research by making offline social network research cheaper, faster, and more reliable. Research on whole life networks typically involves costly paper forms which take months to process. Social Mirror's digital process respects participant privacy while also putting social network analysis within reach of community research and public service evaluation. By providing instant feedback to participants, Social Mirror can also invite people to consider and change their connection to their communities. Our pilot studies have already shown the benefits for people facing social isolation.

415. VoIP Drupal

Leo Burd

VoIP Drupal is an innovative framework that brings the power of voice and Internet-telephony to Drupal sites. It can be used to build hybrid applications that combine regular touchtone phones, web, SMS, Twitter, IM and other communication tools in a variety of ways, facilitating community outreach and providing an online presence to those who are illiterate or do not have regular access to computers. VoIP Drupal will change the way you interact with Drupal, your phone and the web.

416. Vojo.co

Ethan Zuckerman, Rahul Bhargava, Sasha Costanza-Chock and Rebecca Hurwitz

NEW LISTING

Vojo.co is a hosted mobile blogging platform that makes it easy for people to share content to the web from mobile phones via voice calls, SMS, or MMS. Our goal is to make it easier for people in low-income communities to participate in the digital public sphere. You don't need a smart phone or an app to post blog entries or digital stories to Vojo - any phone will do. You don't even need internet access: Vojo lets you create an account via sms and start posting right away. Vojo is powered by the VozMob Drupal Distribution, a customized version of the popular free and open source content management system that is being developed through an ongoing codesign process by day laborers, household workers, and a diverse team from the Institute of Popular Education of Southern California (IDEPSCA).

417. VozMob

Sasha Costanza-Chock

The VozMob Drupal Distribution is Drupal customized as a mobile blogging platform. VozMob has been designed to make it easy to post content to the web from mobile phones via voice calls, SMS, or MMS. You don't need a smart phone or an app to post blog entries - any phone will do. VozMob allows civic journalists in low-income communities to participate in the digital public sphere. Features include groups, tags, geocoding and maps, MMS filters, and new user registration via SMS. Site editors can send multimedia content out to registered users' mobile phones. VozMob Drupal Distribution is developed through an ongoing codesign process by day laborers, household workers, and students from the Institute of Popular Education of Southern California (IDEPSCA.org). The project received early support from the Annenberg School for Communication and Journalism at the University of Southern California, Macarthur/HASTAC, Nokia, and others.

418. What's Up

Leo Burd

What's Up is a set of tools designed to allow people in a small geographic community to share information, plan events and make decisions, using media that's as broadly inclusive as possible. The platform incorporates low cost LED signs, online and paper event calendars and a simple, yet powerful, phone system that is usable with the lowest-end mobile and touch tone phones.