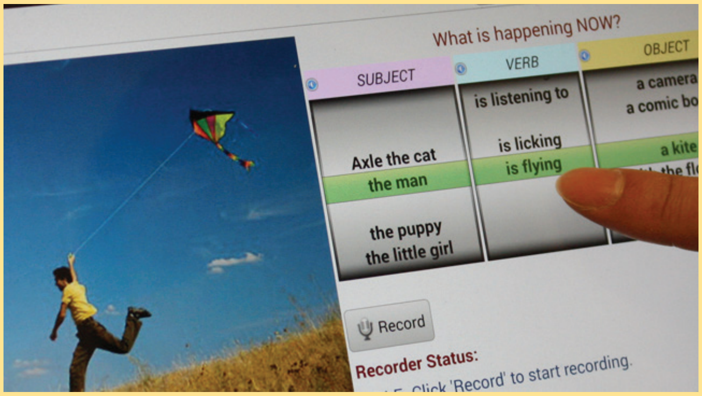
Research@CSE Interactive Systems



The Interactive Systems group at the University of Michigan investigates Human Computer Interaction (HCI), Educational Technology, Multimedia, and Social Computing. HCI is a large and diverse field and the faculty cover many important areas, including strengths in the fundamentals of HCI as well as exciting new technologies and services.

The scientific fundamentals include the domains of human perception and cognition and human factors, social activity, and learning. The applications cover a wide span: user interface design methods, computational sound and music systems, collaboration systems, and educational computing in K-12 settings, with a special emphasis on mobile and ubiquitous computing.

COLLABORATIVE AND SOCIAL COMPUTING

Faculty: Mark Ackerman

Computing has become social. Many computational systems and environments involve some element of user control; increasingly that user control is socially oriented, where digital traces and the crowd allow better interaction. Current research projects include ways to detect problematic logics in conversations (using crowdsourcing and NLP), privacy for sensor data, tying people together for community behavioral health, and user control over sensor networks for spinal cord injury. We also have projects starting in collaborative ways for reusing informal information and using clinician's digital traces to automatically lay out sensor data flows.

COMPUTATIONAL HUMAN-COMPUTER INTERACTION

Faculty: Nikola Banovic

Computational modeling offers a tool to study, describe, and understand complex human behaviors and support optimization and evaluation of user interfaces. It enables a future in which technology will automatically infer user goals, predict future user actions, describe common user behaviors, and even coach users. We study the challenges of trust, fairness, legality, and ethics in creating such systems, which are increasingly making decisions for people and on their behalf. We insist on improving transparency, accountability, and intelligibility of such systems through interaction with their users to minimize harm to society that such systems can cause. Our goal is to create technology that automatically reasons about and acts in response to people's behavior to help them improve the quality of their lives.

COMPUTATIONAL MODELING OF HUMAN EMOTION

Faculty: Emily Mower Provost

Emotion has intrigued researchers for generations. This fascination has permeated the engineering community, motivating the development of affective computational models for classification. However, human emotion remains notoriously difficult to interpret due to the complexity and ambiguity inherent in human emotion expression and due to factors that modulate the data beyond emotion, obscuring the emotional message. The goals of our research are motivated by these complexities. We develop methods that can interpret naturalistic expressions of emotion. Fundamental advances, both in the engineering and in our conceptualization of emotional communication, are needed to support the development of the next generation of affective assistive technologies.

DEEPLY-DIGITAL CURRICULA

Faculty: Elliot Soloway

The new, new is the old, old: the heart of the K-12 classroom is still curricula. But, K-12 is quietly undergoing a profound upheaval: Paper-based textbooks, which have guided teachers since the beginning, are fast fading and the teachers are spending inordinate amounts of time (at night) searching for digital resources to feed their newly minted 1-to-1 classrooms. To support the transition to digital – not just digitized – curricula, the IMLC (Intergalactic Mobile Learning Center) is developing – and promulgating – a suite of device-independent, collabrified, tools – the Collabrify Roadmap System – to support K-12 as it moves to a new generation of curricular materials. Helping K-12 classrooms employ the CRS is driving our research agenda.

COGNITIVE PRINCIPLES AND MODELS IN USER INTERFACE DESIGN

Faculty: David E. Kieras

Developing systems to be easy to use and effective can be accomplished by a simple guess-build-test approach, but this is often slow and expensive. A better approach is first, base the interface design on concepts and principles from human factors and cognitive psychology. Examples: why finding an object on the screen is easiest if it has a distinctive color rather a particular icon; why the mouse and touchscreens are more effective for selecting objects than joysticks, trackballs, or keyboards. Then second, analyze and predict the effectiveness of the design using simulated humans that are based on a cognitive architecture for human perception, cognition, and action, similar to those developed in artificial intelligence. Our research focuses on developing such modeling techniques both for the initial design of the system functionality, and the evaluation of specific detailed interface designs.

CROWDSOURCING AND HUMAN COMPUTATION

Faculty: Walter Lasecki

Human computation incorporates human intelligence into algorithmic processes. It is, at its core, the study of structured work. While workflow, process management, and organizational theory has been developed in great depth previously, the introduction of computer science and computational theory has given us a new lens through which to view organized human efforts, and combine it with the efforts of automated systems. Crowdsourcing — the practice of making an open call to a group of workers to complete a task, often through social computing channels — has created the opportunity to create large-scale human computation systems that are far more capable than current automated systems, but are still available on-demand, at a moment's notice. At Michigan, we are advancing the frontiers of what can be accomplished with human computation and crowdsourcing: exploring how to create systems that respond intelligently, in real-time, and with consistency over time.

AUDITORY SIGNAL PROCESSING AND ENGINEERING (ASPEN)

Faculty: Gregory H. Wakefield

How we hear determines what we hear. Therefore, any systematic understanding of interactive systems involving audio must begin with the human listener and what they perceive. Our research integrates what we know about hearing with what we know about sound producing objects to create and develop a variety of interactive systems. Our most recent efforts are in the areas of immersive spatial audio, vocal pedagogy, and sound quality engineering. We are also interested in exploring fundamental aspects of auditory perception, ranging from elementary pitch perception to the perception of more complex, stochastically organized sounds, and in the integration of what we learn from these studies into models of cognitive architecture.

COMPUTING EDUCATION RESEARCH

Faculty: Mark Guzdial

Code is a powerful tool for automation, but also for expressing ideas, communicating, and thinking about the world. For every professional software developer in the world, there are at least four more adults who program just because it is useful to them. Hundreds of thousands of K-12 students around the world are learning about coding, and we struggle to help enough teachers to understand how to teach with and about code. Computing education research is about how people come to understand computational systems, and how we can improve that process. We use research methods including laboratory experiments, classroom studies, interviews, analysis of public policy data, and large-scale data collection on-line. Our projects help us understand the factors that influence learning to program, that determine where and when computing education is accessible, and that improve how we teach. We design new curriculum and programming environments, with a special emphasis on programming environments that don't look like programming. We aim to provide the benefits of programming as a literacy to learning across the curriculum.

INTERACTIVE SENSING AND COMPUTING GROUP

Faculty: Alanson Sample

The Interactive, Sensing, and Computing lab explores the intersection between humans and computers with research thrusts in ubiquitous sensing, novel interaction methods, mobile health, cyber-physical systems, and the internet of things. Our interdisciplinary group works at the boundary between computer science and electrical engineering with a focus on tackling the critical bottle necks that limit interactive systems with an eye towards reducing deployment barriers and ensuring scalability. By leveraging expertise in circuit design, radio technologies, embedded systems, machine learning, and HCI our research aims to reinvent the physical layer in order to create novel sensing mechanisms, new wireless communication techniques, and innovative ways of harvesting energy and delivering power wirelessly. Our work is typified by taking these underlying technical innovations and building fully functioning systems that allow computers to better understand how people live, work, and play. Then quantifying the effectiveness of these systems through user studies and technical evaluation.

TEMPORAL INFORMATICS AND VISUALIZATION

Faculty: Eytan Adar

Our research includes Internet-scale systems, social network analysis, text mining, and visualization. I work on temporal informatics: the study of the change of information – and our consumption of it – over time. One example is Zoetrope, a way of interacting with the Web that takes into account the fact that Web pages change frequently and it is nearly impossible to find data or follow a link after the underlying page evolves. Zoetrope enables interaction with the historical Web that would otherwise be lost to time by allowing users to interact with content streams. That is, users can look back through previous versions of Web pages and generate visualizations and extractions of the temporal data. We have also done important work on a range of other topics, including social network analysis.

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