

Final Report



TABLE OF CONTENTS

1. [ITU Kaleidoscope 2019 overview](#)
2. [Conference programme](#)
3. [Next Kaleidoscope](#)

[ANNEX – Showcase](#)

1. ITU Kaleidoscope 2019 overview

The [ITU Kaleidoscope conference 2019 \(K-2019\)](#) was kindly hosted by the [Georgia Institute of Technology](#), Atlanta, Georgia, United States, from 4 to 6 December 2019.

Nearly 70 delegates from 16 countries participated at the conference and over 30 participants joined remotely. **Photos** can be seen on the [ITU Flickr](#) and the **webcast** will be shortly available at the [event's webpage](#).

The conference was organized in collaboration with the World Health Organization (WHO), and technically co-sponsored by the Institute of Electrical and Electronics Engineers ([IEEE](#)), the IEEE Communication Society ([IEEE ComSoc](#)) and [The Lancet Digital Health](#).

An 11-month, substantial preparatory process was required for this Kaleidoscope edition. This process involved the efforts and collaboration of six [TSB staff](#), a [Steering Committee](#) of nine members (SC), and a [Technical Programme Committee](#) (TPC) of 75 members, all internationally recognized ICT experts from academia, research institutes and the private sector.

The ITU Secretariat would like to thank the Kaleidoscope 2019 dedicated Steering Committee members: Michael Best (Georgia Institute of Technology, USA), Christoph Dosch (ITU-R Study Group 6 Vice-Chairman; IRT GmbH, Germany), Kai Jakobs (RWTH Aachen University, Germany); Mitsuji Matsumoto (Professor Emeritus Waseda University, Japan), Sameer Pujari (WHO, Geneva), Rupa Sarkar ([The Lancet Digital Health](#), UK), [Mostafa Hashem Sherif](#) (Consultant, USA) and Daidi Zhong (Chongqing University, China); the whole Technical Programme Committee and in particular its Chairman, Mostafa Hashem Sherif, for ensuring transparency through the double-blind peer-review process; and all the partnering organizations which supported the promotion of the conference: Waseda University, the Institute of Image Electronics Engineers of Japan (IIEEJ), the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan, the Chair of Communication and Distributed Systems at RWTH Aachen University, the European Academy for Standardization (EURAS), and the University of the Basque Country.

Special thanks go to [Chaouki Abdallah](#), Executive Vice President for Research, Georgia Institute of Technology, United States and ITU Kaleidoscope 2019 General Chairman, and to all his collaborators, whose invaluable support contributed to making this conference a great success, in particular the Host Committee: Michael Best, Elizabeth Mynatt, Jenifer Hirsch, Pinar Keskinocak, Leigh McCook, Sebnem Ozkan and Alasdair Young.

The Host organized an amazing showcase with reception. Nearly 30 research projects relevant to the conference's theme were presented by their students and creators. Detailed information is available in the [Annex](#).

[Alessia Magliarditi](#), ITU Kaleidoscope Coordinator, chaired the meeting of the Award Committee that selected the winners of the awards for the three best papers. The Award Committee was

composed of four conference attendees: Antoine Bagula (University of the Western Cape, South Africa), Mostafa Hashem Sherif (Kaleidoscope Steering Committee Member and TPC Chair), Jian Song (Tsinghua University, China) and Duncan Sparrell (Consultant, USA). At the Ceremony, Alessia announced the winners of the best paper awards and the recipients of the Young Author Recognition whose certificates were kindly delivered by the two Host Committee Co-Chairs, [Elizabeth Mynatt](#) and [Michael Best](#), together with Mostafa Hashem Sherif.

At the [Closing Session](#), Elizabeth Mynatt and Michael Best gave their closing remarks and Alessia presented some highlights of the conference and thanked all the people that contributed to its success, including her team, Emer Windsor, Erica Campilongo, Simiso Dlodlo and Marine Kern, as well as Matthew Dalais (Communications Officer), Pascal Borde (promotional collaterals) and Gent Bajrami (IT support) from the ITU Telecommunication Standardization Bureau.

2. Conference programme

The Opening Ceremony included welcome remarks from [Chaouki Abdallah](#), Executive Vice President for Research, Georgia Institute of Technology, United States and ITU Kaleidoscope 2019 General Chairman and [Chaesub Lee](#) (Director, Telecommunication Standardization Bureau, ITU) who encouraged the audience to contribute to the ITU-T [Focus Group on "Artificial Intelligence for Health"](#) (FG-AI4H), which aims to establish the foundations for AI to improve healthcare on a global scale, and added that "ITU standardization work for digital health receives essential support from our longstanding partnership with WHO".



After the opening addresses, [Marcelo D'Agostino](#), Senior Advisor, Information Systems and Digital Health, Department of Evidence and Intelligence for Actions in Health, WHO, introduced a keynote speech on *Digital health in the Information Society: Working together to leave no one behind* [[Presentation](#)]. This was followed by an inspiring keynote speech delivered by

[Valerie Montgomery Rice](#), President and Dean, Morehouse College of Medicine, United States on *Leveraging digital health technology to advance health equity*. This session was moderated by [Michael Best](#).

The **Keynote** speech delivered by [Ian F. Akyildiz](#), Georgia Institute of Technology, United States, focused on *PANACEA: An Internet of Bio-NanoThings application for early detection and mitigation of infectious diseases* [[Presentation](#)]. His full keynote summary is available on pg. xiii of the [Conference proceedings](#).

An additional keynote speech was delivered on Day 2 by [John Vertefeuille](#), Centers for Disease Control and Prevention, United States on *Polio eradication and how technology is reaching the last mile*.

In addition to the four keynote speeches, the programme included two **invited papers**:

The first invited paper, co-authored by [Markus A. Wenzel](#), Fraunhofer Heinrich Hertz Institute, Germany, and Thomas Wiegand, Fraunhofer Heinrich Hertz Institute and Technische Universität Berlin, Germany, was presented by Marcus and focused on *Towards international standards for the evaluation of artificial intelligence for health* [[Presentation](#)]. The authors give reasons that standardized benchmarking of AI solutions for health is a necessary complement of established assessment procedures. In particular, they demonstrate that it is beneficial to tackle this topic on a global scale and summarize the achievements of the first year of the ITU/WHO Focus Group on “AI for Health” that has tasked itself to work towards creating these evaluation standards.

The second invited paper on *Preparing for the AI era under the digital health framework* [[Presentation](#)] was authored by [Shan Xu](#), Chunxia Hu and Dong Min, China Academy of Information and Communication Technology (CAICT), China. Shan presented her paper remotely and highlighted the perspective of interaction of ICT on the health industry. An industrial framework of the digital health industry was proposed to better understand the interaction between component factors from the health and ICT sides. Exogenous factors such as a collaboration mechanism, standardization and regulation were proposed and discussed to better prepare for supporting the sustainable development of digital health in the AI era.

38 papers from 18 countries were submitted for review, 20 of which were accepted for publication and presentation from 9 countries (almost all from academic circles).

The research results submitted are related to various ITU activities, including: 5G; digital health; telemedicine, telehealth and biotelemetry; data science and analytics for smart hospitals; smart home; smart services; IoT; standardization of medical IoT; architecture for remote medical interventions using M2M, IoT, sensor networks; health information exchange, interoperability and data integration; safe listening standards; big data modelling, machine learning, artificial intelligence enabled solutions; digital service standards; technology, standardization and innovation for accessibility and digital health applications; data justice; human-data interaction; network availability, survivability, security, cyber-safety and management of privacy; personal health informatics; assistive environments; authentication; biometrics; key exchange; blockchain; data sharing and data protection; performance aspects, such as reliability, quality of service, and

quality of experience; interoperability of systems and applications; digital rights and identity management; legislative and regulatory frameworks; ethical issues. As in previous editions of the conference, a number of papers addressed several radio-related issues.

Presenters made reference to **ITU-T Recommendations** (ITU-T Y.2060 , Overview of the Internet of things; ITU-T. H.870, Guidelines for safe listening devices/systems; ITU-T F.743.1, Requirements for intelligent visual surveillance; ITU-T H.264, Advanced video coding for generic audiovisual services; ITU-T Rec. X.1035, Password-authenticated key exchange (PAK) protocol; ITU-T Rec. X.1080.0, Access control for telebiometrics data protection; ITU-T Rec. X.1081, the telebiometric multimodal model – A framework for the specification of security and safety aspects of telebiometrics); **ITU-R Reports** (Visible light for broadband communication); **study group** activities (ITU-TSG13 - Future networks (& cloud); ITU-T SG16 – Multimedia; ITU-T SG17 – Security; ITU-T SG20 - IoT, smart cities & communities); **focus group** activities (ITU-T FG on AI for Health); etc.

An overview of Kaleidoscope papers and a mapping of papers and ITU activities (i.e. Study Groups, Focus Groups, etc.) has been prepared for the coming meeting of the ITU Telecommunication Standardization Advisory Group (TSAG), and also for the next ITU Radiocommunication Advisory Group (RAG) and the ITU Telecommunication Development Advisory Group (TDAG). Temporary documents providing information on selected papers will be also submitted to the various ITU Study Groups for consideration in their activities.

The authors of the award-winning papers shared the prize fund of CHF 6 000.-.

- **1st prize** (CHF 3 000.-): "Thought-based authenticated key exchange"

Author: Phillip H. Griffin, Griffin Information Security, United States.

Kaleidoscope's winning paper proposes to extend the password-authenticated key exchange

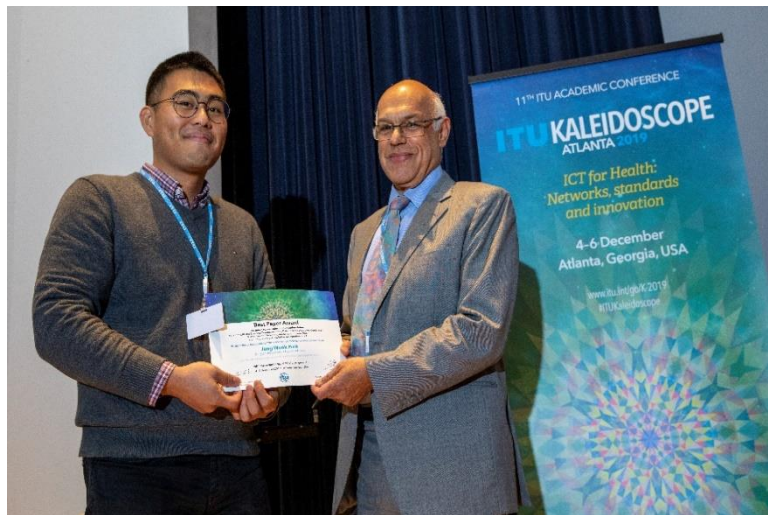


protocols – the weak ‘shared secret’ model of authentication, often dependent on usernames and passwords – with other authentication factors, such as biometrics. The proposal aims to enable secure access to digital health services, especially for people with disabilities relying on assistive devices.

The author is invited to submit contributions to ITU-T SG17.

- **2nd prize** (CHF 2 000.-): *“Redesigning a basic laboratory information system for the global south”*

Authors: Jung Wook Park, Aditi Shah, Rosa I. Arriaga and Santosh Vempala, Georgia Institute of Technology, United States

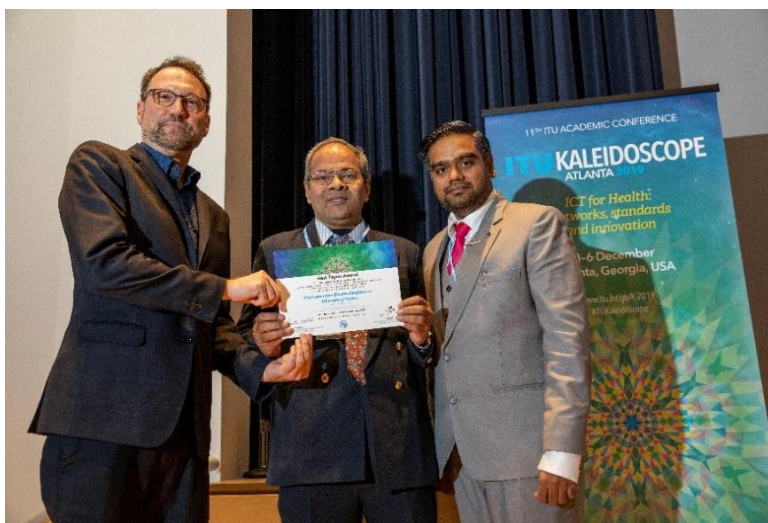


The 2nd prize paper presents a case study of an open-source ‘laboratory information system’ redesigned with improved usability in mind. The system – developed by Georgia Tech and health authorities in the U.S. and Africa – has been deployed in over 100 hospitals in seven African countries since 2010. It aims to ensure highly efficient access to digital health records over devices such as

smartphones or tablets. Users of the latest version of the system in three African countries participated in the paper’s case study.

- **3rd prize** (CHF 1 000.-): *“Elderly health monitoring system with fall detection using multi-feature based person tracking”*

Authors: Dhananjay Kumar, Aswin Kumar Ravikumar and Vivekanandan Dharmalingham, Anna University, India; and Ved P. Kafle, National Institute of Information and Communications Technology, Japan

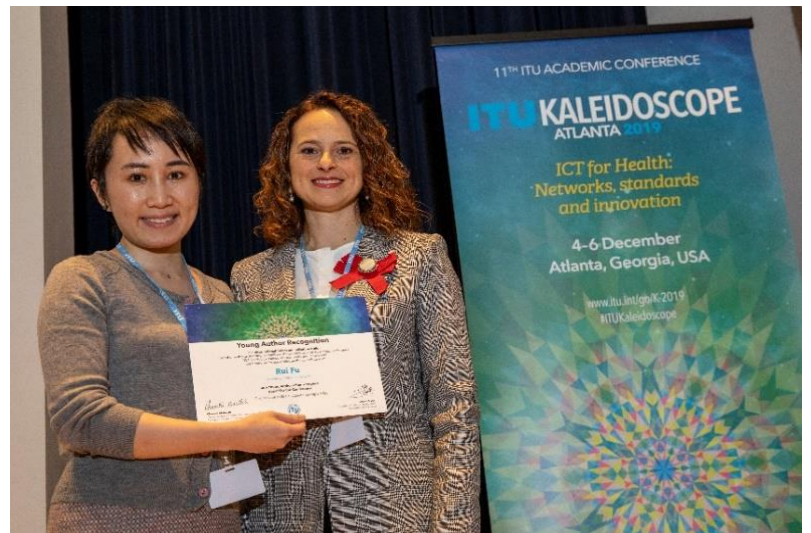
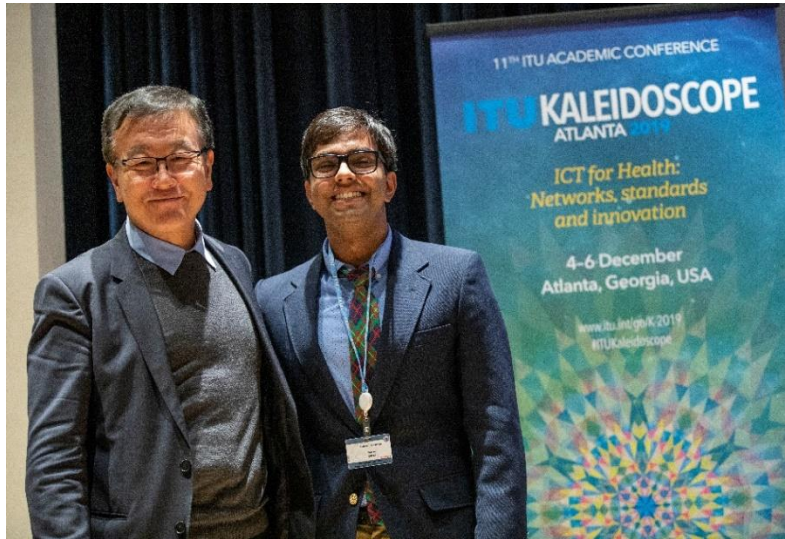


The paper proposes the introduction of a ‘multi-feature-based person tracker’ supported by a vision-based deep learning solution to detect falls among the elderly. The proposed vision-based system is an alternative to the sensor-oriented systems offered by wearable ICT devices. The paper presents research that has shown the proposed system to be capable of a 94.67 per cent precision in

tracking and 98.01 per cent accuracy in fall detection.

The authors are invited to submit contributions to ITU-T SG16.

Alongside the winners of cash prizes, 3 entrants received **Young Author Recognition Certificates**: **Shayan Gupta** (Carnegie Mellon University & Audition Technology, LLC, United States), **Rui Fu** (University of Toronto, Canada) and Di Zhang (Zhenzhou Univerisity, P.R. China & Seoul National University, Korea).



All papers presented at the conference are included in the [Conference Proceedings](#), which are freely available for download on the Kaleidoscope 2019 webpage. They will be also listed in the IEEE *Xplore* digital library.

Programme, presentations, and biographies are available [online](#).

Relevant recommendations and conclusions from the technical sessions, as drafted and presented by the Session Chairs, are available online in PDF format on the programme webpage, [Wrap up session](#).

The conference programme also included two **special sessions**.

The first one, designed and organized by WHO, was moderated by Marcelo D'Agostino and focused on *Digital transformation of the health sector: The power of Artificial Intelligence and the potential of unstructured and Big Data for public health*. Panelists discussed *The power of AI to support patients, families and healthcare providers* ([Yuri Quintana](#), Chief, Division of Clinical Informatics, Beth Israel Deaconess Medical Center, Assistant Professor of Medicine, Harvard Medical School, United States) [[Presentation](#)]; *The potential of unstructured and Big Data for public health* [[Presentation](#)] ([Ian Brooks](#), Director, Center for Health Informatics; Research scientist, School of Information Sciences Faculty Affiliate, NCSA University of Illinois, United States); and *Digital transformation in practice: Challenges and opportunities in Latin America* [[Presentation](#)] ([Jennifer Nelson](#), Digital Health Sector Specialist, Interamerican Development Bank, United States).

The second special session was moderated by Leigh McCook, Georgia Institute of Technology, United States, and addressed *Policy and legal considerations in healthcare*. Panellists were [Brian Scarpelli](#), Senior Global Policy Counsel, Connected Health Initiative, United States [[Presentation](#)] and [Ilise Feitshans](#), Fellow, Law of Nanotechnology, European Scientific Institute Archamps Technopole, France [[Presentation](#)].

3. Next Kaleidoscope

The 12th edition of the ITU Kaleidoscope academic conferences will be held at the [ITU Digital World 2020](#) in Ha Noi, Viet Nam (7-9 September 2020). The theme will be *Industry-driven digital transformation*.

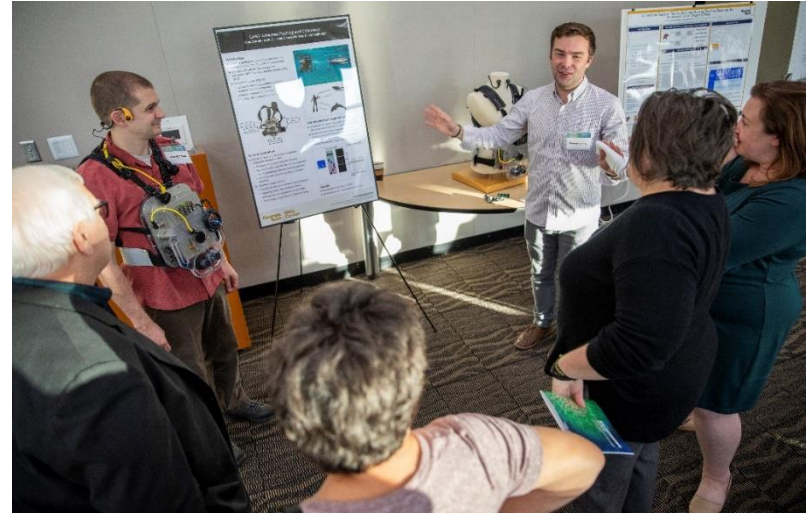
Kaleidoscope 2020 will explore innovations in fields such as robotics, cyber-physical systems, digital twins, virtual simulation, augmented reality, edge computing, artificial intelligence and blockchain – innovations all contributing to the digital transformation of industrial processes.

The call for papers can be found on our home [webpage](#) and accept submissions until 6 April 2020.



ANNEX – Showcase





AFFILIATION	PROJECT SUMMARY	PROJECT CREATOR(S)
GTRI/Georgia Tech MSHCI Program	The goal of this project is to design, and elicit feedback on, the preliminary design concept for a mobile resource tool for the Georgia chapter of the National Alliance on Mental Illness (NAMI-GA).	Courtney crooks
GTRI/Georgia Tech MSHCI Program	In this study, we explored several cyber-psychological factors associated with the university student population. The Digital Natives Assessment Scale (DNAS) (Teo, 2013) was used to assess members of the university student population from a variety of disciplines (N=101) on their familiarity with technology. Several additional questionnaires were also presented, capturing data related to a variety of personality, social, and cognitive factors, as well as a robust social networking survey to capture internet and social media platform behaviors and demographic information.	Courtney crooks
Georgia Tech School of Interactive Computing	The goal of this project is to learn whether social media analysis can support mental health clinicians to assess their patients. To achieve the goal, we developed a prototype of a social media augmented assessment tool and conducted user studies with clinicians in which they explore the tool and provide their own opinions, such as whether they could see medical value in it, whether they could understand the system without a problem, and whether they would like to incorporate the system into their work practices.	Dong Whi Yoo Sindhu Ernala Bahador Saket Kelsie Belan Gregory Abowd Munmun De Choudhury

AFFILIATION	PROJECT SUMMARY	PROJECT CREATOR(S)
Georgia Tech School of Interactive Computing	The goal of the project is to create robust sensing system that fuses a comprehensive suite of multimodal sensing modalities for automated modeling of individual differences and job performance. Twin sub-goals include: 1) validating that our proposed sensing streams fused together via machine learning coupled with ground truth reliably predict both individual differences, and in turn, job performances; 2) successfully creting and demonstrating generalizable models that reliably predict individual differences and job performance through only our proposed sensor data streams. In particular, the sensor data streams include bluetooth beacon data, phone agent, garmin fitness wearable, and social media data.	Koustuv Saha, Vedant Das Swain, Dong Whi Yoo, Gregory D. Abowd, Munmun De Choudhury
Georgia Tech School of Interactive Computing	The FIDO team studies technologies to facilitate communication between working dogs and their handlers, as well as temperament assessment tools.	Melody Jackson, Thad Starner, Clint Zeagler, Ceara Byrne, Larry Freil, Jacob Logas
Georgia Tech School of Interactive Computing	The GT BrainLab studies ways of using brain signals alone to control computers and other devices, to help people with severe motor disabilities as well as mainstream users.	Melody Jackson, Thad Starner, Clint Zeagler, Ceara Byrne, Larry Freil, Jacob Logas
Social Dynamics and Wellbeing Lab	Improving the well-being of people with mental illness requires not only clinical treatment but also social support. This research examines how major life transitions around mental illnesses are exhibited on social media and how social and clinical care intersect around these transitional periods.	Munmun De Choudhury, Sindhu Ernala

AFFILIATION	PROJECT SUMMARY	PROJECT CREATOR(S)
Sonification Lab	Communication is complicated. Face-to-face communication, which many would consider to be the simplest form of communication, becomes a challenge when you consider factors such as differences in language and culture, the use of body language, and tone of voice, etc. These factors inherently make text-based communication more difficult. This project seeks to address these issues through the research and design of communication systems and tools that allow users to gracefully convey such information effectively.	Bruce Walker, Stanley J. Cantrell, Mike Winters
Sonification Lab	Communication is complicated. Face-to-face communication, which many would consider to be the simplest form of communication, becomes a challenge when you consider factors such as differences in language and culture, the use of body language, and tone of voice, etc. These factors inherently make text-based communication more difficult. This project seeks to address these issues through the research and design of communication systems and tools that allow users to gracefully convey such information effectively.	Bruce Walker, Stanley J. Cantrell, Mike Winters
Everyday Computing Lab	We design, deploy, and evaluate mobile health tools that support and meet patients' needs over time from diagnosis of a chronic disease, through treatment and into survivorship. Our research explores the ability for personalized, adaptable, mobile tools to support patients over the course of their individual breast cancer journeys.	Beth Mynatt, Maia Jacobs, Rachel Feinberg

AFFILIATION	PROJECT SUMMARY	PROJECT CREATOR(S)
Everyday Computing Lab	This project aims to define the concept of digital self-harm for the HCI community. In this project we have explored the limited HCI scholarship related to self-harm within a social computing context. We offer the community an operationalized definition of digital self-harm and propose a theoretical base to orientate related research questions into actionable activities. We also describe a research agenda for digital self-harm, highlighting how the HCI community can contribute to the understanding and designing of technologies for self-harm prevention, mitigation, and treatment.	Elizabeth Mynatt, Jessica Pater
Georgia Tech and Emory University	A new transdisciplinary program led by Georgia Tech and Emory to create therapeutic programs, innovations in home and mobile technology, and transformative built environments to empower individuals with mild cognitive impairment and their informal care partners.	Elizabeth Mynatt, Craig Zimring, Jennifer Dubose, Brian Jones, Jeremy Johnson, Brad Fain and many terrific faculty colleagues, Aparna Ramesh, Cooper Link, Judah Krug
Health Experience and Applications Lab (Hx Lab)	Diagnostic radiology reports are increasingly being made available to patients and their family members. However, these reports are not typically comprehensible to lay, recipients, impeding effective communication about report findings. Rapport is a prototype system that aims to facilitate communication about radiology imaging findings among paediatric patients, their family members and clinicians in the clinical setting.	Lauren Wilcox, Matthew Hong, Clayton Feustel, Chaitanya Bapat, Serena Tan

AFFILIATION	PROJECT SUMMARY	PROJECT CREATOR(S)
Health Experience and Applications Lab (Hx Lab)	CO-OP is an interactive mHealth application that utilizes visual illustrations of everyday illness experiences to investigate how technology can support chronically ill patients and family caregivers' collaborative effort to track and co-create personally meaningful representations of everyday illness experiences in non-clinical settings. The system will elicit and probe patients' and family caregivers' observations of illness experiences in relation to everyday activities, and their design input--through a suit of media technology readily available on their mobile device.	Lauren Wilcox, Rosa Arriaga, Matthew Hong, Jung Wook Park
Georgia Tech School of Interactive Computing	OptoSense is a self-powered ambient light sensing surface using commodity photodetectors and photovoltaics on flexible substrates to detect user activities and interactions, such as walking activities and step counting.	Dingtian Zhang, Jung Wook Park, Gregory Abowd, Thad Starner, and many colleagues including Georgia Tech Center for Organic Photonics and Electronics (COPE)
Georgia Tech Research Institute	Engaging Patients and Their Families in Creating More Efficient Patient Centered Care	Megan Denham
Institute for People and Technology and Emory University	Evaluate screening strategies for diabetes type 2 in terms of effectiveness, disparities, and downstream resources required	Doug Bodner, Shivani Patel, Mo Ali, Megha Khan

AFFILIATION	PROJECT SUMMARY	PROJECT CREATOR(S)
Georgia Tech School of Interactive Computing	The goal of this project is to evaluate the efficacy of infrastructure-sensed WiFi data for inferring group activities of college students and use such inference for predicting academic performance.	Hyeokhyen Kwon Vedant Das Swain Bahador Saket Mehrab Bin Morshed Munmun De Choudhury Thomas Ploetz Gregory D. Abowd
Georgia Tech School of Interactive Computing	The goal of this project is to use a real-time eating detection system to understand the eating behavior of college students and investigate how certain behaviors are correlated with students' mental well-being.	Mehrab Bin Morshed Samruddhi Kulkarni Thomas Ploetz Gregory D. Abowd
Georgia Tech School of Interactive Computing	Investigating user-centered design process for improving food journaling experience for college students	Pallavi Chetia Ye-Ji Kim Preston Choe Thomas Ploetz Gregory D. Abowd
Georgia Tech School of Interactive Computing	In the last few years, there has been tremendous growth in the prevalence and widespread use of smart and ubiquitous technologies. These technologies include the use of smartphones, smartwatches and wearables, and smart devices. While these devices have a variety of benefits, they come at the cost of using our data for number of purposes that is not transparent to an average user. This project aims to understand how people perceive regarding privacy concerns with respect to their health data being collected and used by third party entities.	Sooah Moon James O'Connor Koustuv Saha Mehrab Bin Morshed Sauvik Das Munmun De Choudhury Thomas Ploetz Gregory D. Abowd

AFFILIATION	PROJECT SUMMARY	PROJECT CREATOR(S)
Center for Inclusive Design and Innovation	Overview of a series of studies investigating the potential of tele-technology to deliver an evidence-based Tai Chi interventions to adults aging with mobility disabilities	Tracy Mitzner, Elena Remillard, Jordan Chen, and Kara Cohen
Georgia Tech ISyE / Center for Health and Humanitarian Systems	Developing a decision support tool to help patients decide whether to accept an organ offer or wait for a 'better' quality organ	Kirthana Hampapur, Pinar Keskinocak, Ethan Mark, David Goldsman, Brian Gurbaxani, Joel Sokol
Georgia Tech ISyE / Mayo Clinic	This web-based tool aims to improve prenatal care by providing a personalized informational and decision-support tool that integrates the medical history and preferences of the expectant parents. The goal of the tool is to facilitate informed decision-making regarding screening and diagnostic testing during prenatal care.	Akane Fujimoto, Pinar Keskinocak, Turgay Ayer, Jia Yan, Kalyan Pasupathy, Santiago Romero-Brufau, Mustafa Sir, Myra Wick, Lars Nielsen, Laura Rust
Contextual Computing Group	CopyCat and PopSign are two games that help deaf children and their parents acquire language skills in American Sign Language. 95% of deaf children are born to hearing parents, and most of those parents never learn enough sign language to teach their children. As short-term memory skills are learned from acquiring a language, many deaf children enter school with the short-term memory of fewer than 3 items, much less than hearing children of hearing parents or Deaf children of Deaf parents. Our systems address this problem directly.	Thad Starner, Cheryl Wang, Kshitish Deo, Aditya Vishwanath

AFFILIATION	PROJECT SUMMARY	PROJECT CREATOR(S)
Contextual Computing Group	Working with Dr. Denise Herzing of the Wild Dolphin Project, we are creating wearable computers for conducting two-way communication experiments with cetaceans. With CHAT, one researcher uses the waterproof system to broadcast a sound, associated with an object with which dolphins like to play. A second researcher, upon detecting the sound, passes the object to the first. The researchers pass objects back and forth, further associating the sound with the object. The goal is to see if the dolphins mimic the sound in order to "ask" for the play object.	Thad Starner, Scott Gilliland, Chad Ramey
Computer-Mediated Communication, Social Computing, Accessibility	Emojis have become the ubiquitous language of the 21st century. People across a variety of cultures use emojis, but do we know what they actually mean? We deployed a survey to capture the meanings of the 100 most commonly used emojis on Twitter.	Stanley J. Cantrell, Sonam Singh, Dr. Bruce Walker
