



The Georgia Tech Aware Home

Supporting Research, Partnerships,
Students, and Beyond

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Technology Center



Outline

- Aware Home Research Initiative
- Aware Home Facility
- Research Utilizing the Aware Home and How
- Student Engagement
- Industry Engagement
- Administrative Aspects

Aware Home Research Initiative (AHRI)

An interdisciplinary research endeavor addressing the challenges facing the future of domestic technologies

- Biomedical Engineering
 - Broadband Institute
 - Center for Assistive Technology and Environmental Access (CATEA)
 - Center for Research & Education on Aging & Technology Enhancement (CREATE)
 - Digital Media
 - Electrical and Computer Engineering
 - Georgia Tech Research Institute (GTRI)
 - GVU Center
 - Health Systems Institute
 - School of Industrial Design
 - School of Interactive Computing
 - Interactive Media Technology Center
 - RERC TechSage
 - Research Network Operations Center
 - Robotics and Intelligent Machines
 - Wireless RERC
- + Many external partners/ collaborators
- Academic researchers
 - Industry
 - Service Providers

The Aware Home

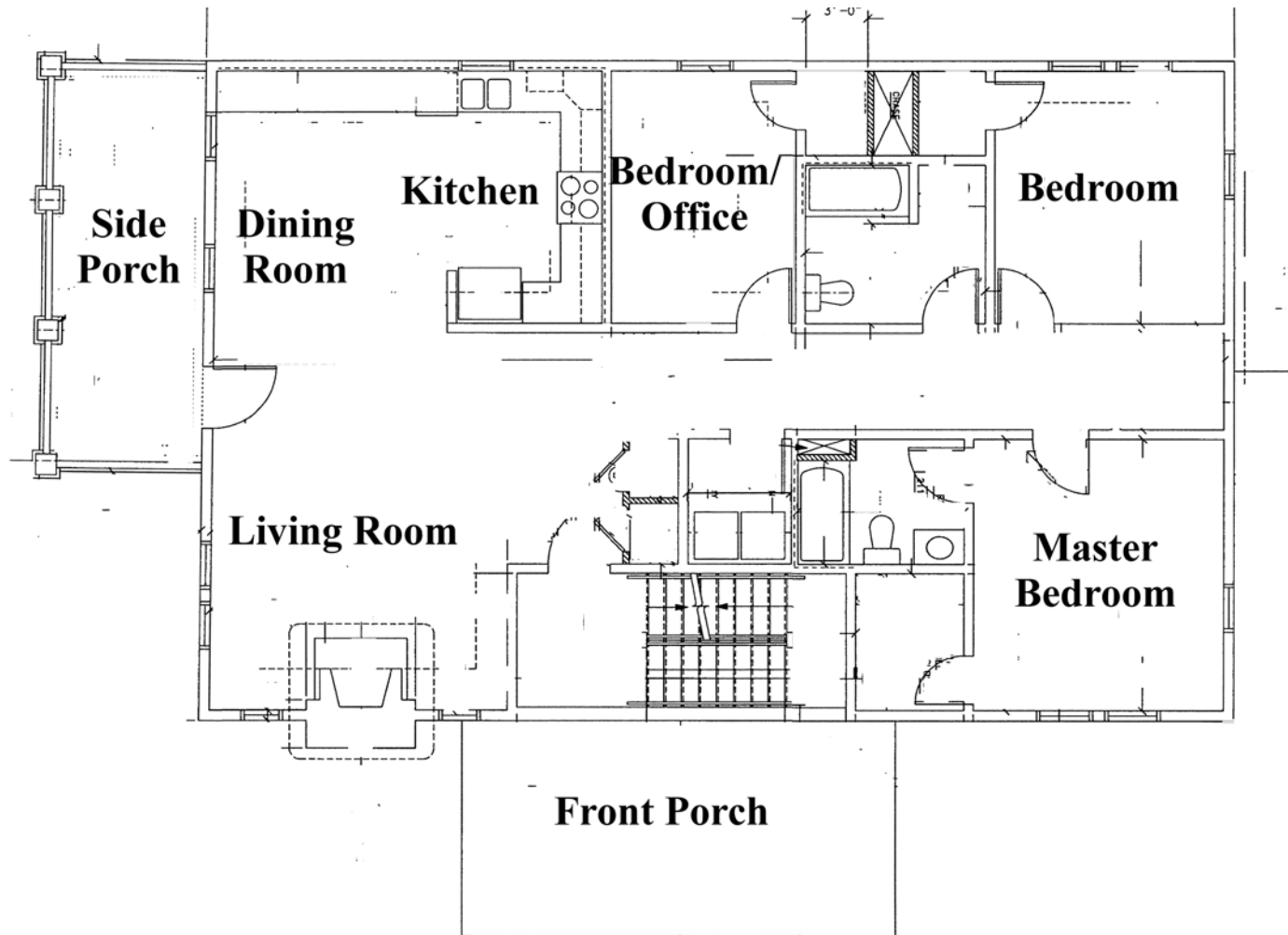


The Aware Home



The Aware Home

Two identical floors (3 bedroom, 2 bath), basement, and attic



Design Features



- Hardwood and carpet floors
- Wide halls and doors
- Push to open cabinets/drawers
- Easy open door handles
- Indirect and soft lighting
- Low specular surface
- Bathroom grab bars
- Drop ceiling / Power above ceiling
- Circuit per room
- 6" Wide walls, wood construction
- 4" conduits from basement to attic
- Wire trays in halls and around rooms
- Conduits from above drop ceiling to wall plates

1st floor living room



1st floor kitchen



1st floor hall



1st floor office



2nd floor



2nd floor kitchen/dining room



2nd floor living room



Supporting Research and Engagement

The Aware Home provides an authentic home environment in which to:

Develop

Innovate the next home technology

(assistive robotics, future home monitoring, whole-home gaming)

Evaluate

Perform research studies in a controlled environment

(behavior imaging, connected data intelligence, bathroom transfers)

Refine

Test solutions before deploying into peoples' actual homes

(ambient alerting, data 2 healthy decisions)

Engage

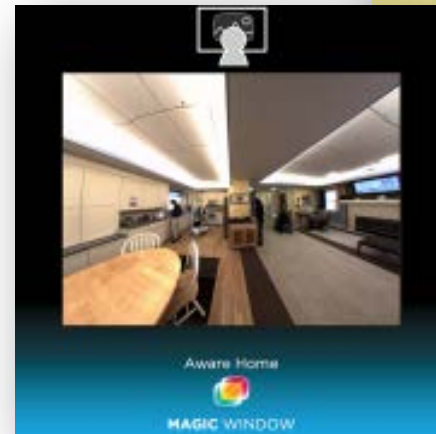
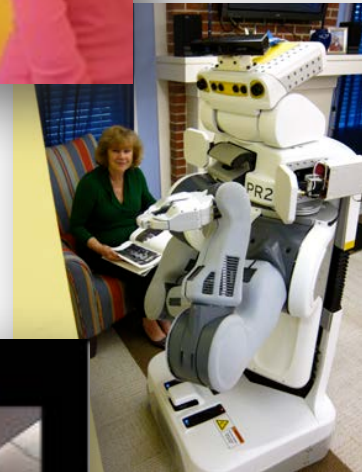
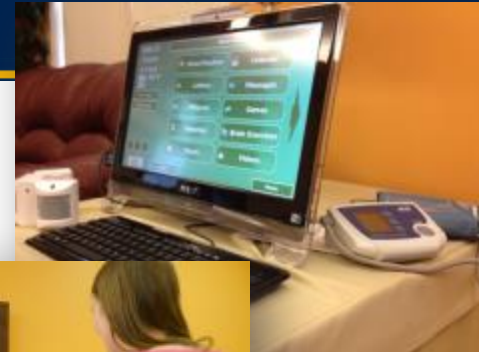
Student & industry engagement

(class projects, competitions, seminars, pet projects)



Research Areas

- **Health and Wellness at Home**
 - Aging in place / independence, chronic care, health self-management, wellness, social communication
- **Digital Media and Entertainment**
 - Future of entertainment, gaming, media delivery, and network management
- **Sustainability**
 - Energy and water resource management, behavior change
- **Future Tools for the Home**
 - Leverage infrastructure to enable applications and reduce cost



Research Projects: Independence, Wellness, Health

AWARE HOME USES

Supporting Healthy Aging: Early Projects

Develop

Evaluate

Refine

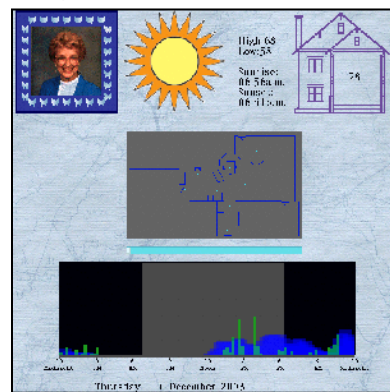
- Digital Family Portrait
Leveraging smart home sensing to detect behavior patterns to share with family. Variation Social connectedness through DFP.
- Memory Mirror – track medications with RFID provide timeline of med-taking
- FETCH - find lost objects with bluetooth tag and voice control



Memory Mirror (Tran & Mynatt)



FETCH (Kientz, Patel, Tybekhan, & Abowd)



Digital Family Portrait (Rowan, Mynatt et al)

Supporting Independence

Develop

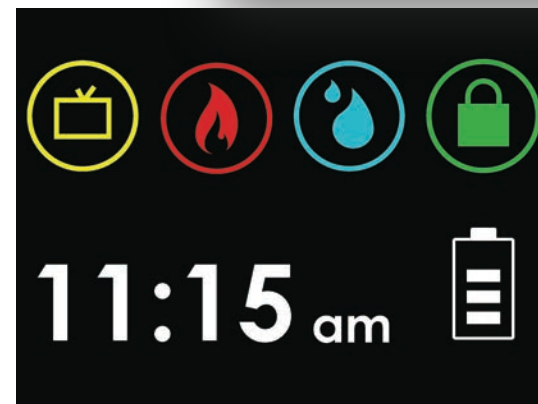
Evaluate

Refine

Ambient Alerting

Jones et al

Using **analytics** of common smarthome sensing and providing gentle **ambient alerting** in the environment as well as **wearable alert options**, CUE was envisioned as an enabling solution that would cue residents to act and be more accepted by the resident.



Robotic Assistants for Older Adults

Develop

Evaluate

Refine



Training light switch manipulation



Manipulation of light switch (error and success)



Manipulation of items into tray

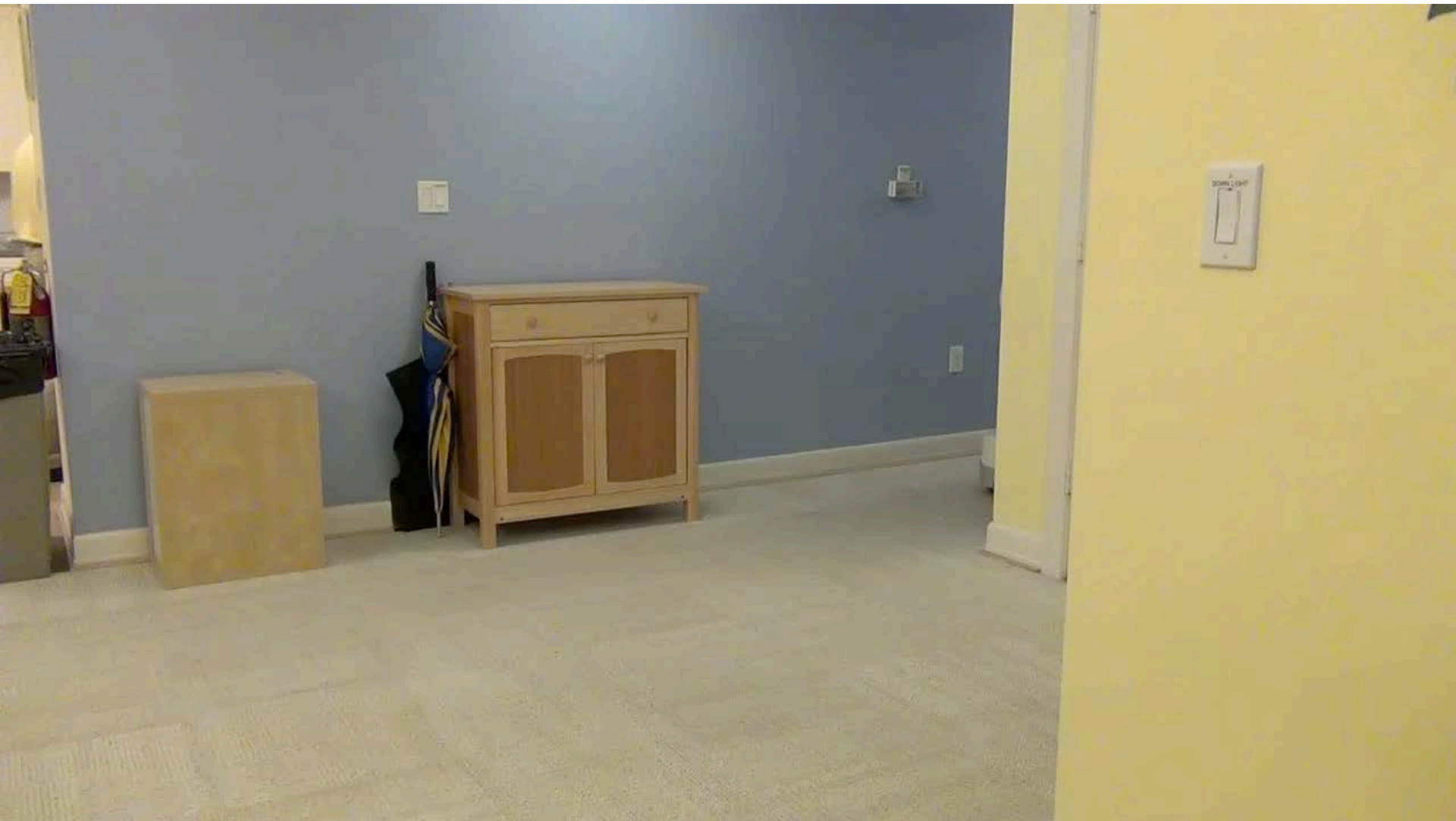


Delivery of medication



Turtlebot Medication Delivery Video

Robotic Assistants for Older Adults



Robotic Assistants for Older Adults

Automatic Delivery of Medication & Hydration
for Older Adults

Georgia Institute of Technology

2012

Victor Emeli Alan Wagner Charles C. Kemp

SmartBathroom Lab

Develop

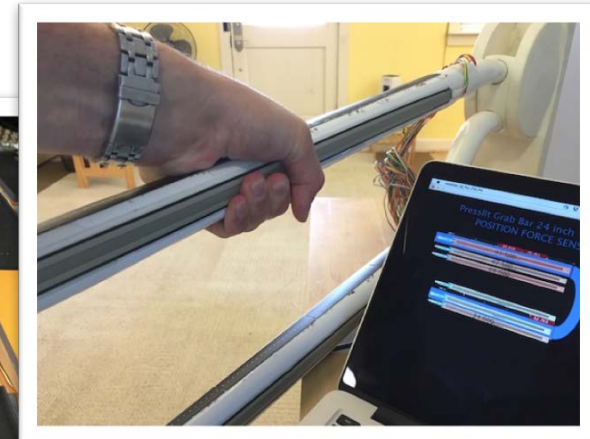
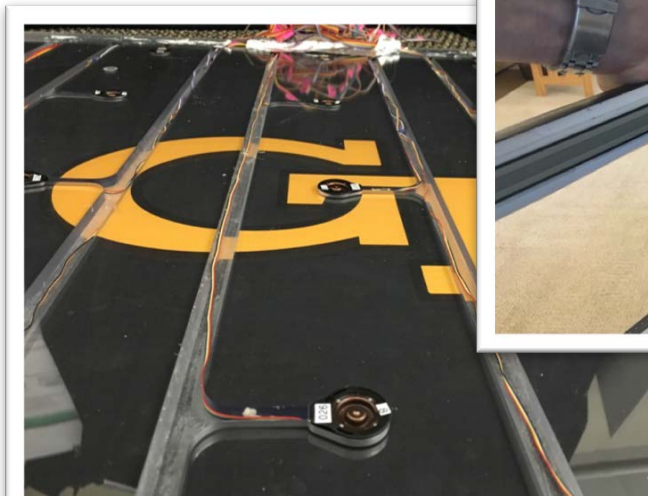
Evaluate

Refine

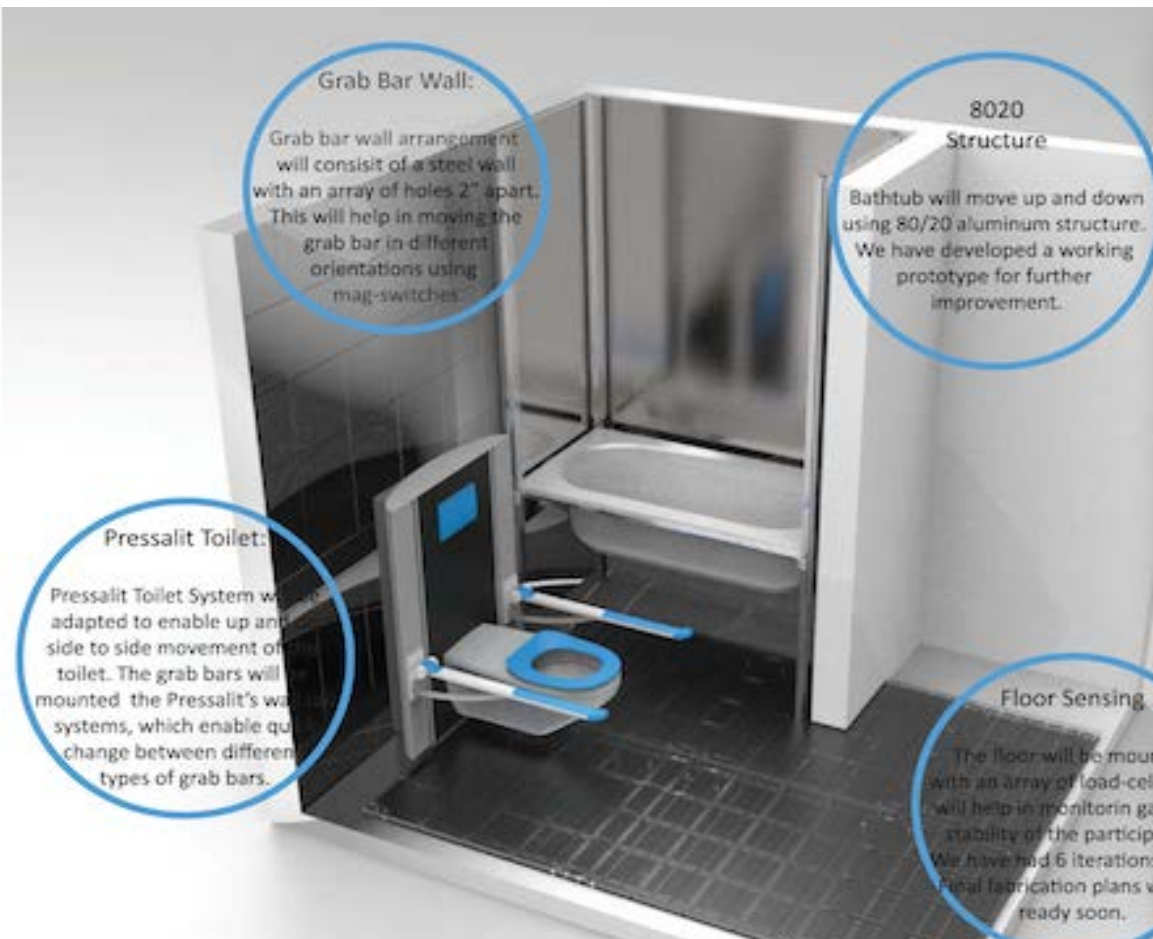
RERC TechSAGE

Sanford, Jones

- Instrument home bathroom with sensing and automated adjustment of bathroom fixtures
- Explore benefits to people who are ambulatory but with functional limitations
- Consider naturalistic gait speed monitoring & other indicators of reduced function
- Develop predictive model for automated adjustment



SmartBathroom Lab In-progress



Smartbathroom rendered and installed in Aware Home (work in-progress)

Social Communication Tools

Design

Engage

Sympathetic Devices: Everyday Technologies for Older Adults

Claudia Rebola, Industrial Design

Designing accessible solutions
for communicating with younger
generations w/o computer
knowledge



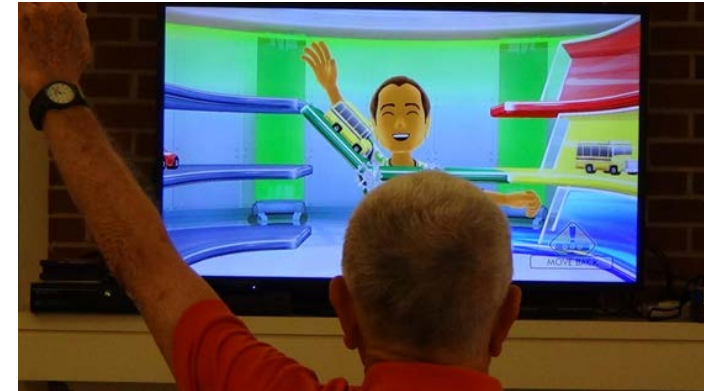
VISTA, Simple Communication
Laura Mitchell, ID student concept
Claudia Rebola, Instructor

Exergaming

Evaluate

Exergaming

Harrington, Hartley, Mitzner, Rogers



Screen Camera: Behind participant



Ppt Camera: In front of participant

Chronic Disease Self-Management

Develop

Evaluate

Refine

Improving Outcomes in Persons with Heart Failure and Diabetes

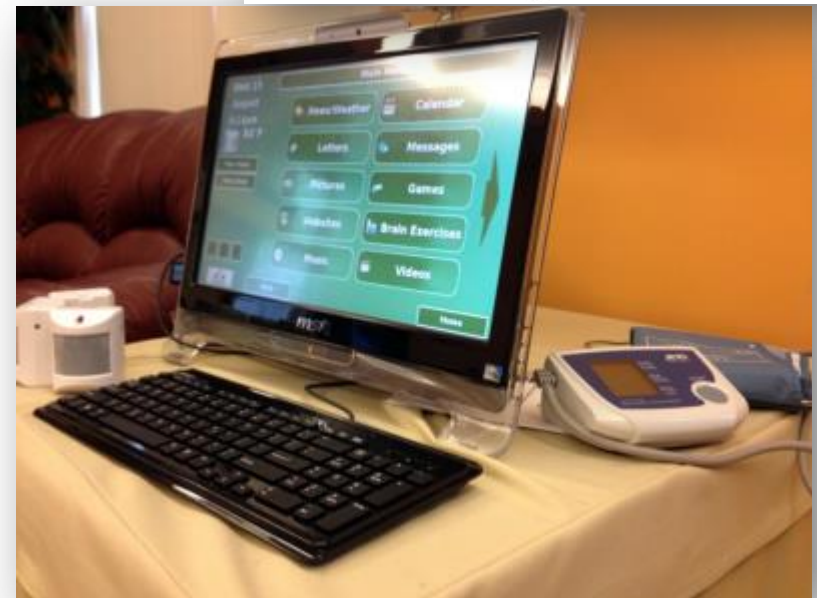
Sandi Dunbar, Emory School of Nursing

Brian Jones, AHRI

Dew Anne Lancome, Ho'okele Health

Leveraging existing home health platform in educating patients with HF / diabetes mellitus comorbidity on management of their conditions.

Funded by: The Atlanta Clinical and Translational Science Institute (ACTSI)



Ho'okele Health iHealthHome Navigator

Technology and Autism Agenda

Develop

Evaluate

Refine

Supporting the continuum of care now and in the future

Clinical Research Support

Much of our technology has been developed to support therapists and clinicians in gathering quantitative and qualitative data about interventions delivered to children. The data collected by our technologies can be used to reflect upon and evaluate the effectiveness of the intervention, the progress of the child, and promote collaboration among therapists.

Abaris



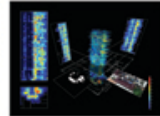
Supporting Discrete Trial Training therapists with technology that augments paper recording practices to associate data directly to video

CareLog



Supporting simplified collection of Functional Behavior Analysis

Viz-A-Viz



Visualizing human behavior over long time periods, allowing new questions to be asked and answered

Early Detection

Technological tools that leverage everyday practices can be crucial in the screening and early detection of autism. Technology geared toward early detection and intervention can range from software proactively asking for developmental data to intelligent, automated algorithms that analyze the social and play behaviors of children.

BabySteps / KidCam



Proactive software and mobile computing technology to motivate collection of data on developmental progress for a child and sharing it with others

Rapid ABC



A 2-minute screening procedure administered at well child visits. The design of the form allows simplified data collection and increases the value of the information for families and practitioners.

Child'sPlay & Social Game Retrieval



Wireless smart toys and computer vision supporting the automatic capture, access, and retrospective review of child behavior



Developing Individual Interventions

Technology is invaluable to the development of new interventions and can be designed to support existing practices. The future in this area includes the use of artificial intelligence and the power of the Web to reach more individuals with personalized interventions.

Refl-ex



Computer-based intervention designed to improve social problem solving skills by guiding the user as they navigate a social situation.

ContextMel



Investigates how stereotypical repetitive behaviors exhibited by individuals with Autism relate to their physiological characteristics and the external environment.

Modeling Autism

Computational cognitive models can begin to unravel our understanding of the autism phenotypes. This can lead to better paradigms for communication, education, and training for individuals on the autism spectrum.

VITA



A model of a disposition towards visual reasoning as a "phenotype" of autism, and related tools and methods for assessment and intervention

Sponsors

NSF, NICHD, Organization for Autism Research, Autism Speaks, Google, Microsoft Research, Children's Healthcare of Atlanta, ARCS Georgia Tech Gvu Center, GT/Emory Health Systems Institute,

Research Projects: **Connected Home & Infrastructure**

AWARE HOME USES

Context in Video

Develop

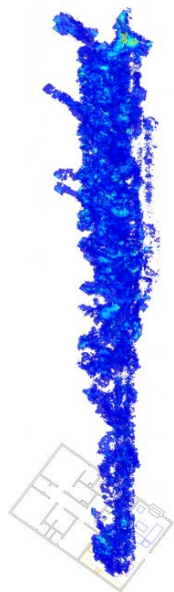
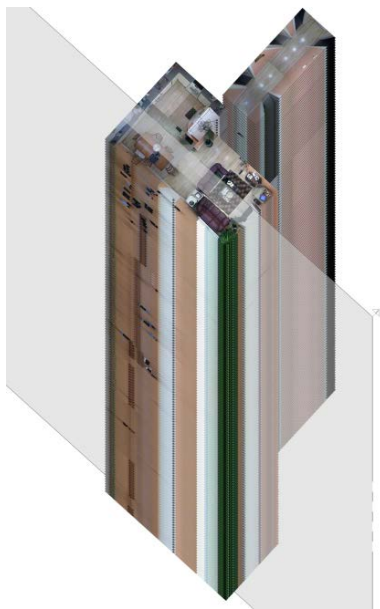
Evaluate

Refine

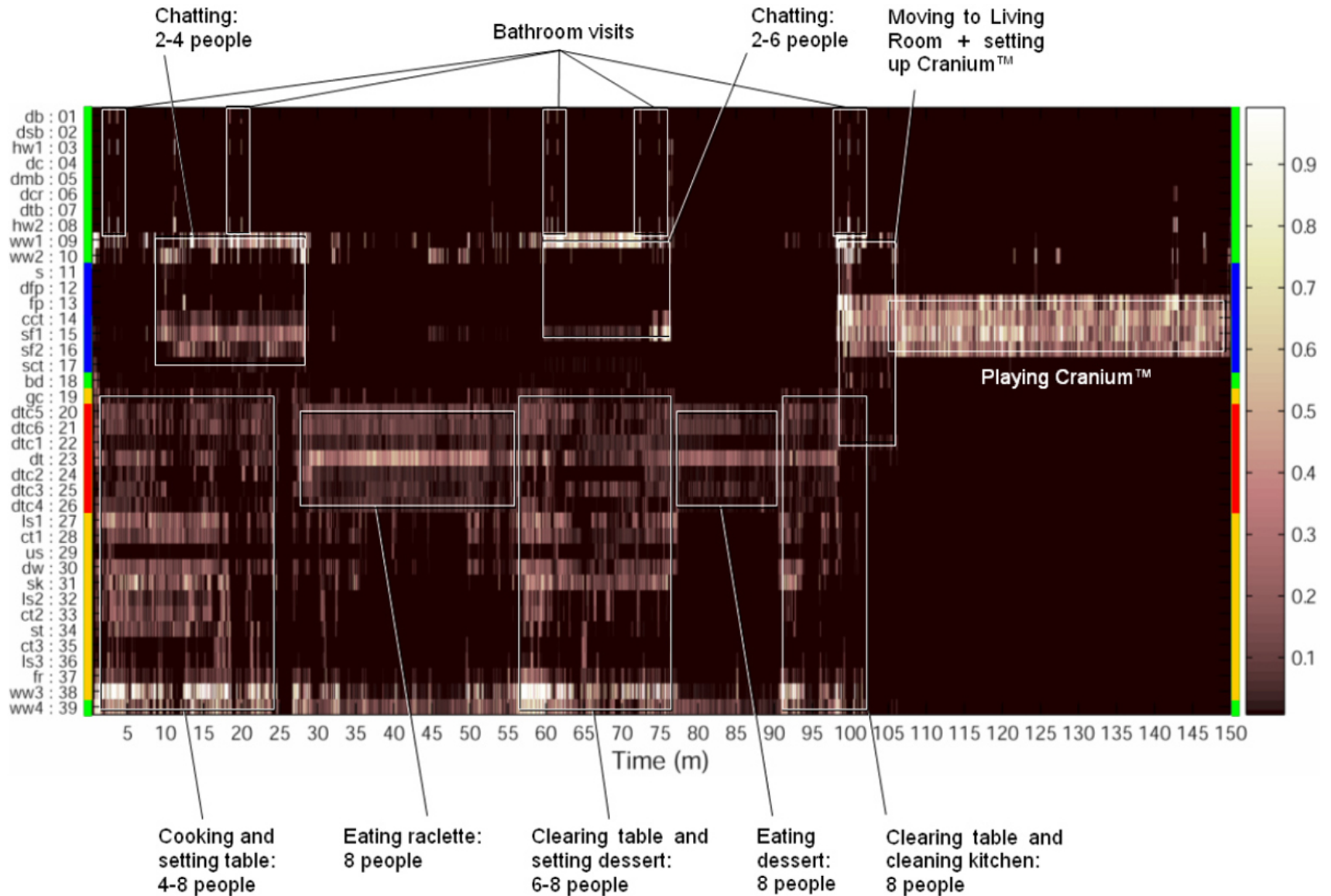
Viz-a-Vis

Mario Romero, Gregory Abowd @ Georgia Tech

- Understanding of activity context
- Focus on specific regions of interest
- Provides visualization of activity over time



Context in Video



Sensors in the Home: Leveraging the Infrastructure

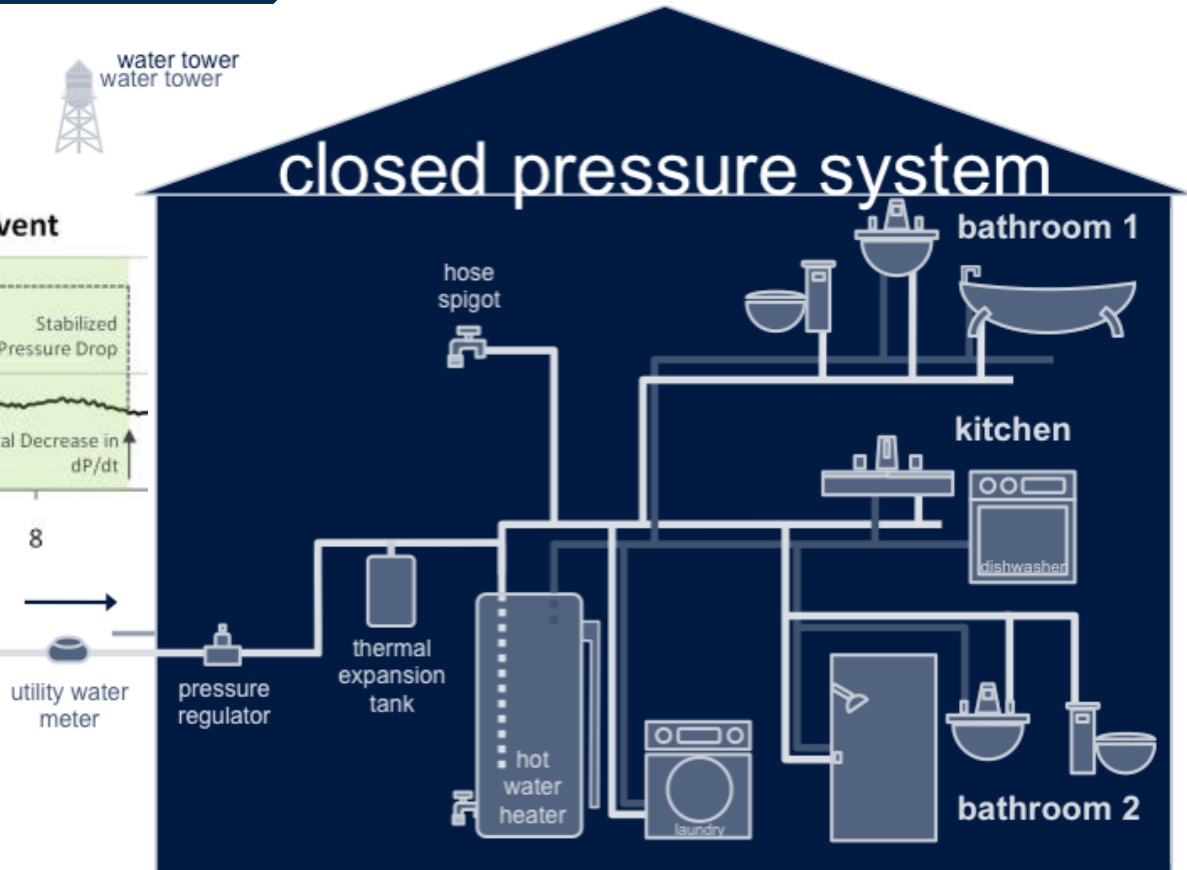
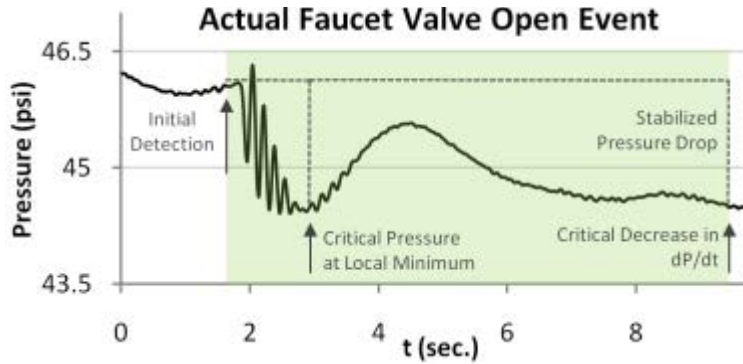
Develop

Evaluate

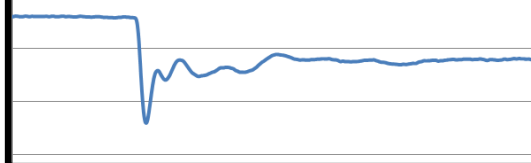
Refine

Hydrosense

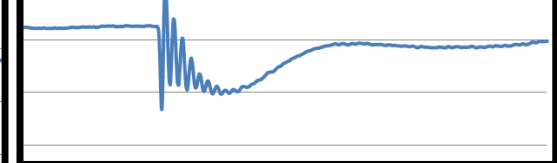
Abowd, Patel, E. Thomaz



toilet



kitchen sink cold



Sensors in the Home: Leveraging the Infrastructure

Develop

Evaluate

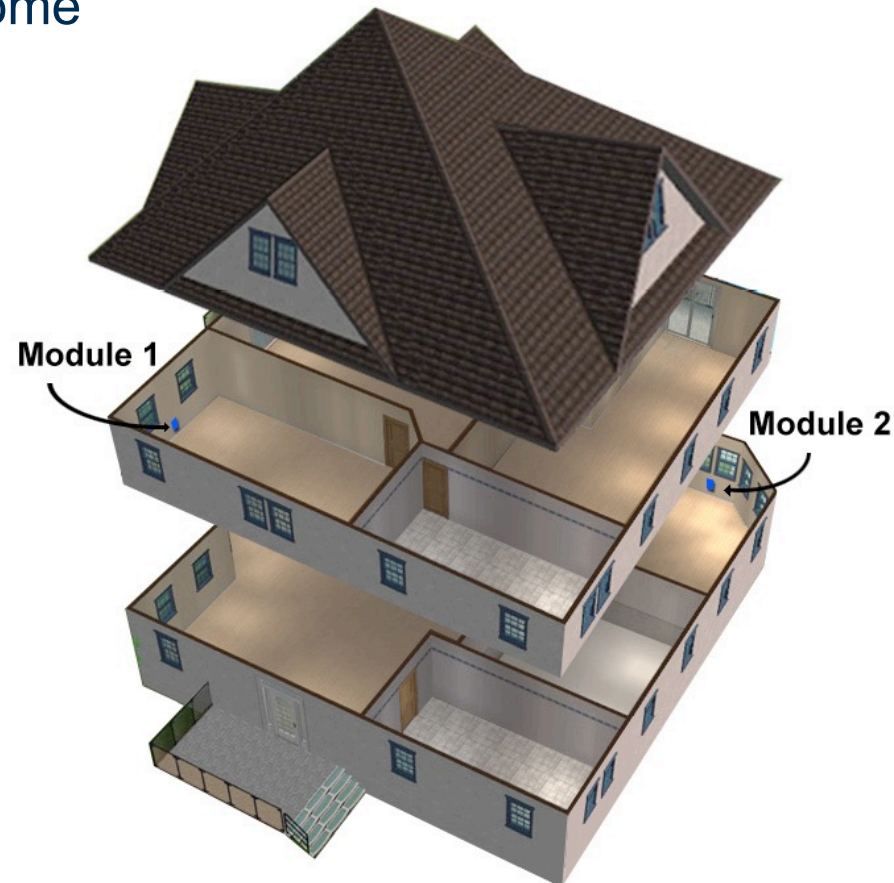
Refine

Powerline Positioning (location aware)

Patel, Truong, Abowd

Determine the location of items in the home using a dual source radio signal utilizing powerlines as an antenna

Powerline Event Detection



Cooking Data Collection

Develop

Evaluate

Intel Science and Technology Center – Pervasive Computing

Jim Rehg

Collect data from multiple subjects performing cooking of eight different recipes using RGBD and head mount cameras. Three locations were used in the kitchen – stove top, kitchen sink, and food preparation area beside the fridge. Analyze data to detect and identify food.

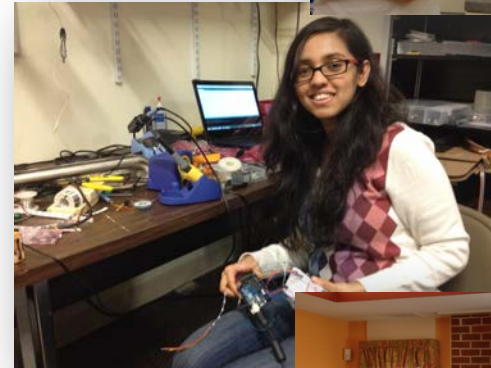


Examples of student projects with Aware Home as an integral part

STUDENT ENGAGEMENT

Student Engagement Overview

- Sponsored research projects
- Internal pet projects
- Industry projects
- Lab management
- Special problems credit
- Class/club projects
- Competitions
- Class tours
- Seminars
- Showcases
- Hackshops



Students: Class Projects

- Human Computer Interaction
- Mobile Ubiquitous Computing
- Industrial Design Studios
- Engineering Psychology
- Real-time Embedded Systems
- ...

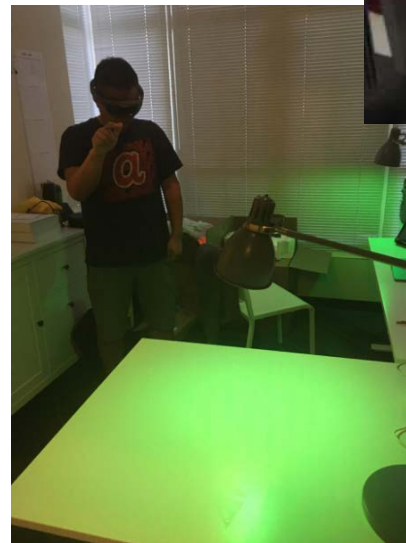
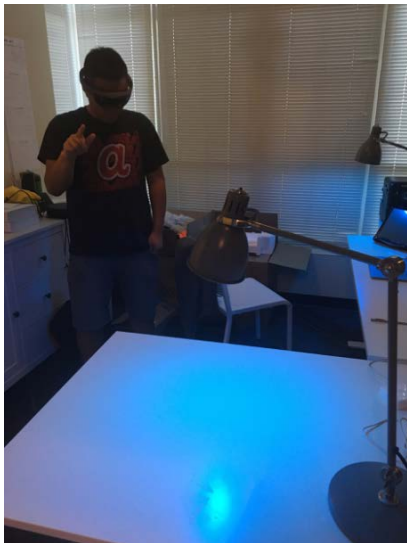


Students: Special Problems

Whole Home Gaming

Dong Whi Yoo, Maribeth Gandy Coleman, Brian Jones

Demonstrate use of hololens for control of the connected home environment through a game interaction



Students: Special Problems

Data Driven Smart Home Jayanth Krishna, Brian Jones

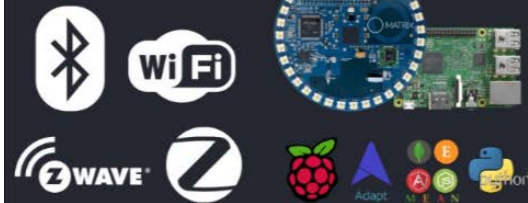
Leverage existing smart home solutions, develop local data management and rules, demonstrate interoperability with multiple systems



Data Driven Smart Home Jayanth Mohana Krishna, Brian Jones



Protocol Stacks



Actions API



Graphical User Interface

Web based app
Physical location mapping
Control on/off, up/down
Add devices
Configure supported APIs



Smart Assistants

Contextual cards
Prompting users
Get cues from device
Works across platforms

Voice

Amazon Echo
Google Home
Remote for elderly



Dynamic buttons

One-push workflow
Time-sensitive context



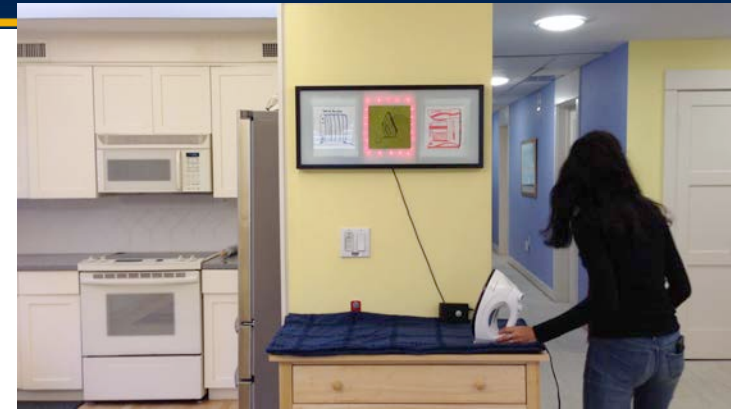
Messaging interface

Slack-based notifications
SMS for offline access
Emails



Students: Aware Home Pet Projects

Ambient Alerting
 Connected Living Demonstrations
 Whole Home Gaming



ARWARE HOME

WHOLE-HOUSE GAMING WITH MAPPED PROJECTIONS & KINECT

ABOUT ARWARE HOME

With the introduction of affordable depth cameras such as the Microsoft Kinect, as well as the development of micro projectors, the time is approaching when paired projectors and cameras (processors) will be as ubiquitous as the common household light bulb.

The ARWare Home project explores various modes of interaction and affordances that would accompany a home-based system of processes that would turn every surface of the house into an interactive game space.

The prototype developed here begins to define the various ways in which a user can interact with the space as well as the type of content that is available. From video games, to calendars, to autonomous interaction when not receiving user input, this research explores how people interact and respond to continuously present digital interactions.

By leveraging the power of a Kinect (v2) as a short throw projector, the ARWare Home quickly becomes a calibrated, mapped space throughout which we can render an digital landscape that leverages both human interaction and physical objects to create and compelling experience.

HARDWARE SETUP

SENSOR RELEASED - A Kinect sensor, depth camera, and projector are positioned throughout the space, the sensors are calibrated to the space and the projectors are positioned to project content onto the walls.

PROXIMITY INTERACTIONS

PROJECTOR RELEASED - Projectors are positioned throughout the space, the projectors are calibrated to the space and the projectors are positioned to project content onto the walls.

SAMPLE GAME PLAY

MAP - A 3D visualization of the house layout and the location of the sensors and projectors.

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SHOWCASE / TOURS

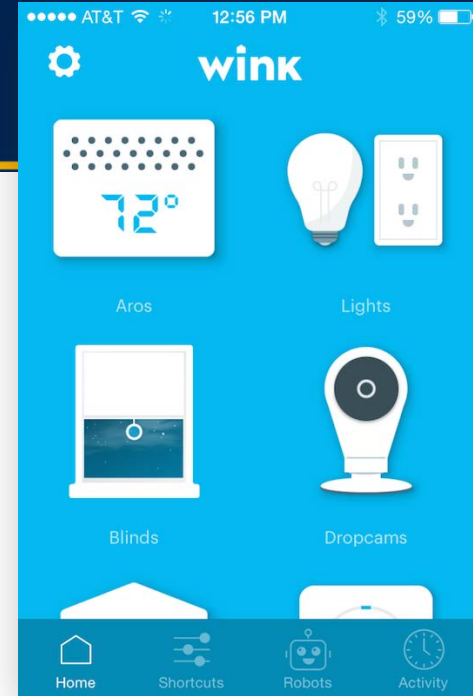
Showcase

- VIP demonstrations / tours
- Industry tours
- Video/news shoots
- Open house showcases
- Consumer education



INDUSTRY ENGAGEMENT

Connected Living Infrastructure



Evaluate acceptance / preferences?

Demonstrate solutions

Research next-gen products/services

amazon echo
amazon.com/echo



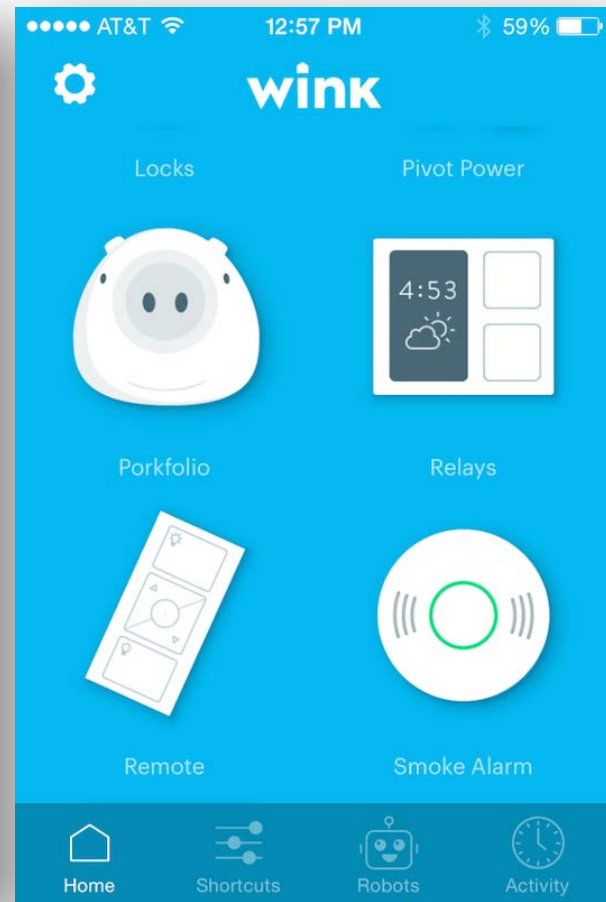
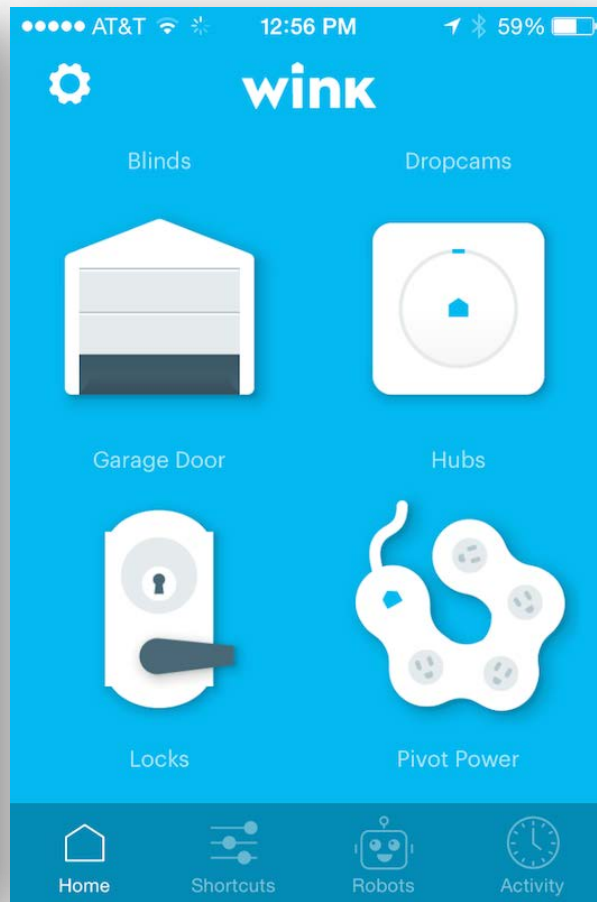
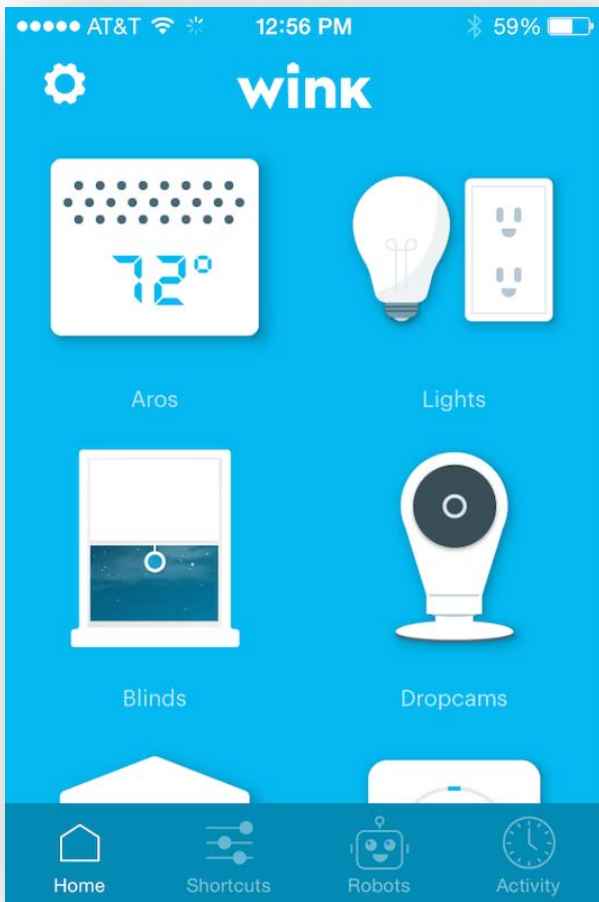
Example of an Industry Engagement Utilizing the Aware Home

FLEXTRONICS @ THE AWARE HOME

Connected Home Interoperability



Interoperability: Wink App



1st floor Living Room



1st Floor Kitchen



2nd Floor Kitchen



Basement Conf Room



2nd floor bedrooms



Founding, Funding, Operations

ADMINISTRATION

Initial Funding

Georgia Research Alliance

- Grant to fund the construction of the Aware Home and initial startup equipment
- Ongoing funding through GT for maintenance

Broadband Institute

- Broadband Institute Industrial Advisory Board

College of Computing

- Networking support (switches, etc)

Ongoing Funding

Grants

- NSF ITR
- NIDRR,
- NSF SDSET
- NSF ERC
- NIH/NIA

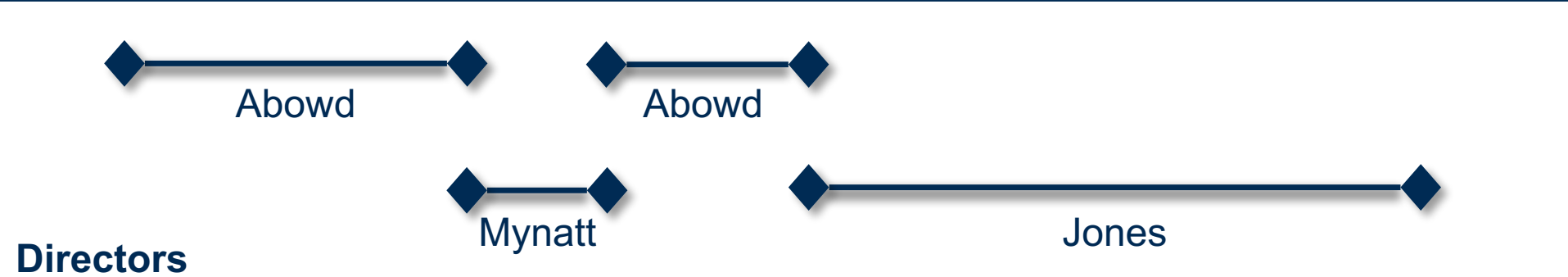
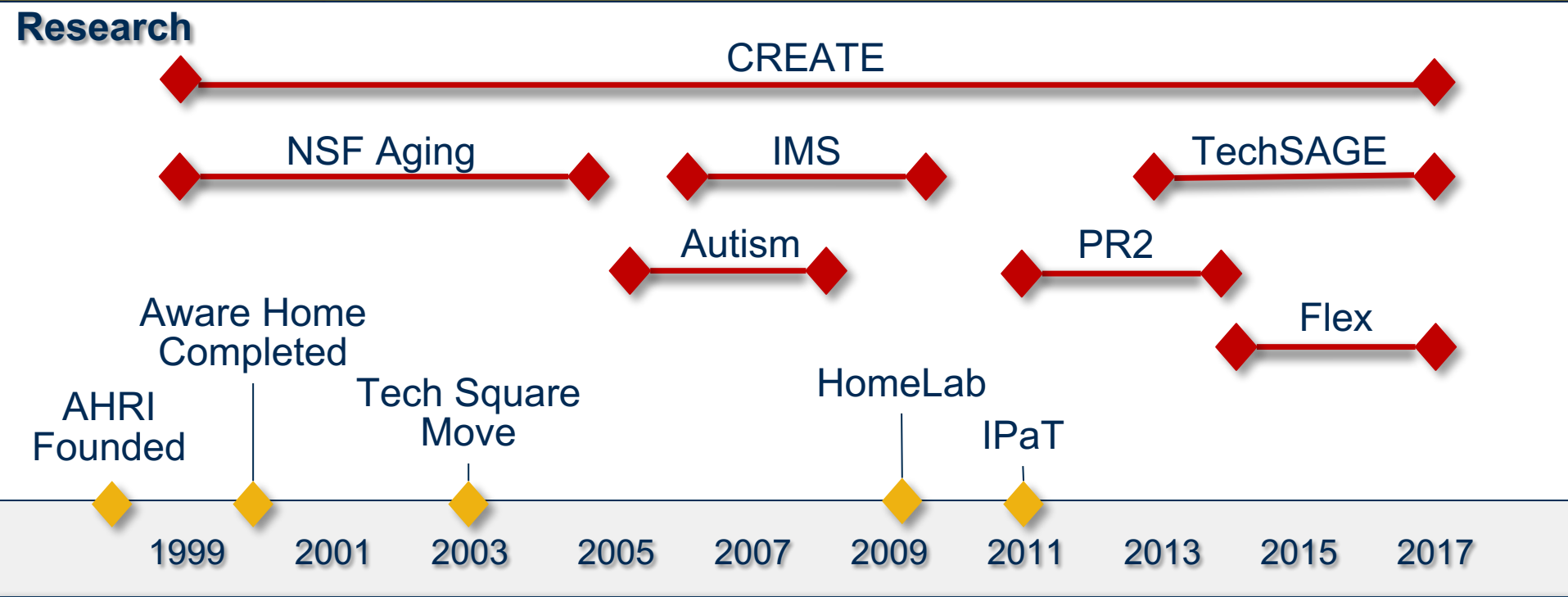
Industry

- GVU Center
- Connected home
- Connected health

Internal

- GVU Center
- Institute for People and Technology (IPaT)

Significant Projects, Funding, and Events



Management Considerations

Facility

- Maintenance
- Infrastructure
- Scheduling
- Access
- Upgrades

Research

- Faculty Involvement
- Student Involvement
- Facility impact

Marketing

- Industry
- Media
- Faculty
- Students

Outreach

- Website
 - facility & research
- Partners
- Publications
- Tours / Showcases
- Target audience

Brian Jones brian.jones@imtc.gatech.edu

QUESTIONS?



Questions?

Brian D. Jones, MSEE

Director, The Aware Home Living Lab
Senior Research Engineer, Interactive Media
Technology Center



Georgia Institute
of **Technology**