



Smart Aging: Connecting Communities Using Low-Cost and Secure Sensing Technologies

NSF 1951880

Fan Ye, Stony Brook University

Award Type: IRG, Solicitation Year: IRG-1, FY2020

Principal Research Investigators

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Community Partners (26 in total)

- Resident and Community Groups
 - The Osher Lifelong Learning Institute (OLLI)
 - Long Island State Veterans Home
 - San Simeon by the Sound Center for Nursing and Rehabilitation
 - Oyster Bay Senior Campus
 - The Suffolk Care Collaborative
- Nonprofit and Philanthropic Organizations
 - Long Island National Aging in Place Council
 - AARP New York
 - Continuing Care Leadership Coalition, New York
- Health Care Providers
 - Stony Brook University Hospital (SBUH): Medicine Telehealth, Department of Emergency Medicine, Critical Care and Sleep Medicine, Primary Care
 - GB Audiology, Great Neck, NY
 - Meeting House Lane Medical Practice
 - SUNY College of Optometry
- Government Stakeholders
 - Office for the Aging, Suffolk County and New York State
 - Suffolk Cooperative Library System
 - NYS Center of Excellence on Wireless and IT Technology

Project Overview

Visual Schematic



Project Vision

- Engage diverse community stakeholders (e.g., older adults, caregivers, supporting institutions and professionals) to collaboratively:
 - develop robust, secure, affordable health data sensing and analytic solutions to automate health change detection and prediction
 - design social solutions to foster greater technology adoption, effective data sharing, and quantitative measures of social determinants of health.
- Enable older adults to maintain quality of life, autonomy and dignity while aging in place; alleviate the social, economic burdens on communities, stakeholders and the healthcare system; educate and train residents, providers for technology assisted aging in place.

Project Overview

Use-Inspired Research

- Large and growing percentages of 65+ older adults aging in Suffolk County, NY and the nation (25% and 13%) are creating a “Silver Tsunami”
- 80+% of older adults want to live independently at home with quality of life, autonomy and dignity, causing a social and economic crisis, overwhelming care providers, facilities and hospitals, thus motivating:
 - the need for robust, secure in-home sensing technologies to monitor older adults’ physical and mental health status;
 - social solutions for effective technology adoption and utilization by stakeholders.

Fundamental Research Contributions

- Robust, secure, affordable sensing technologies for longitudinal monitoring of vital signs, physical activities and social interactions of older adults, and analytics for detection of emergencies, early indicators of health changes in a privacy-preserving, nonintrusive manner.
- Social solutions to foster positive perceptions and greater adoption of technologies, effective data representation and delivery means to stakeholders, and quantitative, data-driven measures for social determinants of health.

Project Update

Technology

- Developed a sensing prototype using a UWB radio and depth camera for non-touch heart and respiration rate estimation
- Validated in an engineering lab and achieved reasonable performance for stationary human subjects
- Secured IRB approvals and in partnership with the SBU cardio-pulmonary exercise lab collected sensor and clinical data on 36 patients to further understand its performance in realistic settings

Social Science/Outreach

- Secured IRB approvals and conducted 7 discussion groups with 73 older adults to understand perceptions and obstacles in technology adoption.
- Created 5 patient-case vignettes to facilitate future discussions about technology adoption which can be tailored to audiences from different cultural and educational backgrounds
- Working with health care facilities and religious leaders to expand outreach and engage diverse populations
- Presented our work at industry, community and academic venues (HIMSS20, OLLI, School of Social Welfare course on aging)
- Developed and teaching an undergrad course on aging and technology
- Recruited students from multiple disciplines to work on the project with continued expansion through our courses



Radio sensor setup

Project Evolution

We learned from discussion groups and other stakeholders that:

- *Older adults want to maintain not just quality of life but also autonomy and dignity while aging.*
- *As individuals age, they spend increasing amounts of time at or close to home*
- *Wearables present great physical and cognitive challenges to older adults and may miss most critical events due to non-compliance of wearing (e.g., falls in bathrooms).*
- *In general, a positive correlation exists between people's social-economic status and acceptance of in-home sensing technologies; while a negative correlation between their health status and acceptance.*
- *Many people are wary of the potential privacy and security implications, or even downright suspicious, distrustful of technologies.*
- *The pandemic has exacerbated challenges for us and older adults (e.g., isolation, shopping), but also heightened the awareness on the needs and roles of technology, even accelerated the use and acceptance in some older adults.*

We decided to:

- *Focus on touchless, nonwearable sensing that does not pose any physical or cognitive burden on older adults.*
- *Use coarse grained depth sensors instead of regular cameras to balance between privacy and fidelity.*
- *Create multiple vignettes with "fictional personalities" customized and relatable to audiences from different cultural and economic backgrounds to facilitate discussions and provide a context for the benefits of home-based sensing technologies.*
- *Adapt to the pandemic by using online tools for discussion groups and surveys*

Anticipated Outcomes & Success Measures for Next Year

- Validation of the suitability and maturity of sensing hardware using a simulated home environment
 - Outfit a special “Home of the Future Lab” with multiple sensor deployments covering different areas (e.g., living room, bedroom).
 - Develop a suite of simulated events and activities (e.g., fall on the floor, sleeping, eating, reading, watching TV) to map out sensor installment (e.g., height and number) and identify potential performance issues
 - Further improve sensing hardware and develop guidelines in deployment and usage to ensure data quality under variations (e.g., gender, age, clothes, distance, orientation).
- A comprehensive understanding of attitudes and perception obstacles toward sensing technology adoption by multiple stakeholder groups
 - Create multiple vignettes utilizing fictional characters that represent diverse cultures, economic backgrounds and living situations to illustrate and contrast the benefits of having and possible consequences of not having in-home sensors. Utilize these vignettes to facilitate dialogue in diverse older adult discussion groups.
 - Explore physicians, nurses, social workers, and professional and family caregiver perspectives of utilizing sensing technologies.
- Invite students from our courses to join our research group for more diversified backgrounds and experiences

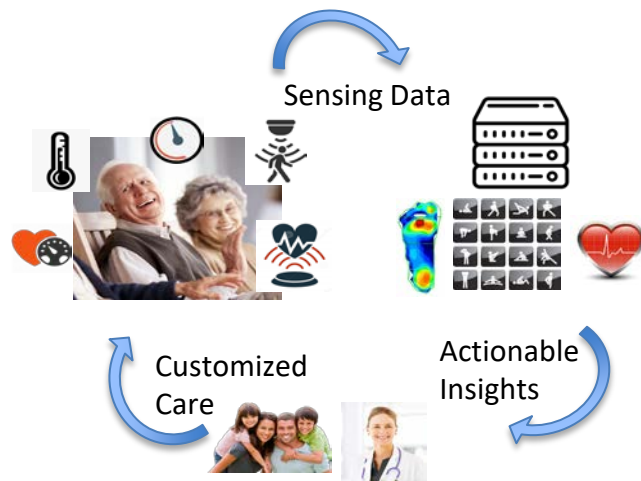
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