Penn
University of Pennsylvania
Artificial Intelligence and Technology Collaboratory for Healthy Aging

PILOT AWARDEES 2022-2023

https://www.pennaitech.org

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AUTOTUNE ME

TITLE: A MUSIC-BASED MOBILE APP TO COMBAT NEUROPSYCHIATRIC SYMPTOMS IN PEOPLE LIVING WITH ADRD

Kendra Ray, PhD

The purpose of this pilot project is to develop a mobile application “TuneMind” that detects pulse and sedentary movements of homebound individuals with Alzheimer’s disease and related dementias (ADRD) and triggers auto-play of personalized songs in a wearable device. By collecting quantitative and qualitative data from the app and users, we will test the acceptability and feasibility of the app. This app will be an important tool to include in daily caregiving in a home setting by extending established benefits of music therapy for people with ADRD. The aims are as follows:

Aim 1. Develop TuneMind. TuneMind will be developed to respond to changes in the pattern of heart rate and sedentary behaviors of people with ADRD. An algorithm will be created to (1) find changes of the heart rate to trigger the application to play music; (2) adaptively improve learning when music is needed, e.g., time of day; (3) predict the music dose required to better control heart rate and movement.

Aim 2. Test the usability of the app. A total of 10 stakeholders will be asked to test TuneMind for two weeks. Based on a survey and focus groups, improvements will be made to app.

Aim 3. Determine the performance and usability of the app for use by people with ADRD and their family caregivers at home. Twenty dyads will be recruited to test TuneMind for two weeks. We will collect physiological measures based on the app’s demonstration to auto-play music according to pulse and/or sedentary states.

https://autotuneme.org/

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bestiebot

TITLE: RGBD+ THERMAL COMPUTER VISION PLATFORM FOR HOME MONITORING AND TELEHEALTH

Richard Everts

We're developing a new class of a home-based, AI-enabled monitoring system that usesstandard computer vision and thermal sensors to detect falls, notify caretakers in case of falland perform basic health diagnostics, all with industry-exceeding privacy and accuracy.

Specifically, we will:

1. Detect falls more reliably in day and night conditions
2. Increase the capabilities of remote health checks through mobility and thermal testing
3. Reduce AI biases for the BIPOC population through our data generation tools and methods

Using unique sensor fusion along with a patented new AI system, our goal is to vastly increasethe reliability, adoption, and privacy of in-home monitoring systems for use by those aging inplace and their families.

https://bestiebot.com/

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TITLE: PHYSIOLOGICAL DETECTION AND MONITORING OF ALZHEIMER'S DISEASE

David Yonce, MS, MBA

Cogwear has developed a wireless dry-sensor EEG wearable that can easily collect clinical-grade brainwave data anywhere, anytime with comfort and no limits on mobility. Initially applied to behavioral health, here we propose to extend our platform to early detection and trending of dementia and Alzheimer's Disease (AD) based upon brain physiology. With the ability to sense EEG from the frontal and temporal lobes, the parts of the brain that regulate short and long-term memory, planning, and executive functions, our system can detect EEG changes implicated in dementia and AD: slowing, reduced complexity, decrease in synchronization, and neuromodulatory deficits.

Our project will focus on two components: migrating our wearable to a soft goods form factor with downsized electronics more appropriate for in-clinic and home use and begin to develop the EEG signal processing and applications to quantitatively detect and trend brain processes associated with dementia and AD. Deliverables will include an advanced prototype and pilot testing of algorithms with humans in a small sample of healthy and AD/ADRD patients.

Our expectation is that these algorithms will ultimately show efficacy to detect pre-symptomatic brain changes, allowing intervention by caregivers to prepare patients and families. Further, because subtle EEG shifts can be indicative of changing disease states, we can provide quantitative trending of AD based upon brain physiology, providing new methods to titrate pharmaceuticals and evaluate disease treatments. Through earlier detection and enhanced monitoring, our goal is to better support patients and their families by enabling more years of high-functioning and independent living.

https://www.cogweartech.com/ PennAITech YouTube Feature

GW Public Health

CROSSWATER DIGITAL MEDIA

TITLE: AI-ENABLED CONVERSATIONS TO MEASURE MENTAL STATUS AND MANAGE PSYCHOTROPIC MEDICATION USE

Lorens Helmchen

Continuous monitoring of cognitive function among the elderly is vital for early detection and proper management of Alzheimer's Disease and related dementias. Similarly, continuous monitoring of changes in mood is indispensable for the appropriate dosing of psychotropic medication.

Yet, current means of monitoring cognitive function and mood among the elderly are often infrequent, inconsistent, and imprecise because they rely on the completion of standardized questionnaires that may fail to flag clinically relevant leading indicators.

This project aims to deploy and validate the use of digital "conversation companions", a remote patient-monitoring technology that can be installed on tablet computers and smartphones by untrained caregivers or the elderly themselves.

The recordings and transcripts of the conversations between elderly residents and these digital companions will be used to train machine-learning algorithms that can measure the presence and severity of dementia and depression and predict fall risk.

Expert clinicians, family members, and community stakeholders will ensure that the predictions are clinically informative, actionable, transparent, and culturally appropriate.

As the technology can be used by patients on their own and as the voice and the visuals of the digital conversation companions can be adapted to a patient's linguistic and cultural background, this technology can reach traditionally under-served patient populations such as racial minorities and those living in remote areas.

This technology will allow caregivers to detect small and subtle changes in an individual's cognitive function and mood in a way that is less intrusive, more frequent, more consistent, and more precise than current practice.

https://www.gwu.edu/ https://crosswater.net/ PennAITech YouTube Feature

TITLE: AI-ASSISTED FALL DETECTION AND REMOTE MONITORING FOR SENIORS WITH ADRD

David Stout

Falls are a significant contributor to health decline in older adults. Iris Technology Inc is using a proprietary AI Vision architecture to build a better fall detection and prevention solution for use in health care facilities and eventually home care environments. Our proprietary AI architecture, Deep Detection™, will revolutionize how we detect and even prevent falls by allowing us to create highly accurate models with minimal training data, and by generalizing and incorporating context to provide deeper insights. Our solutions operate entirely on the edge, ensuring patient privacy in the health care setting and giving users total control over their data. In partnership with UPenn and the National Institute of Aging, our project is focused on harnessing the unique capabilities of our AI to create a model that can more accurately detect fall events and learn when the risk of a fall is high to support preventative intervention. Our ultimate vision is to build a full suite of tools and a library of models that can facilitate better, more personalized care for seniors that both enables greater independence and fully protects their privacy without the need for expensive or unscalable monitoring. There is an ever-growing need to develop good technology that can ease the increasing burden on caregivers and help ensure that seniors are receiving the highest levels of care. Iris Technology's mission is to empower people to solve humanity’s unsolvable problems, and we are confident that we can help to develop cutting-edge AI that will help solve real-world problems facing seniors and caregivers today.

https://www.poweredbyiris.io/

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KODAHEALTH

TITLE: PATIENT-SURROGATE ALIGNMENT IN DIGITAL ADVANCE CARE PLANNING

Desh Mohan, MD

Advance Care Planning (ACP) encompasses educating patients on potential future healthcare decisions, clarifying patients' values and healthcare preferences, and sharing decisions with family and care providers. Most individuals lacking decision-making capacity near end-of-life will need a surrogate decision maker (SDM) to make or voice decisions for them. However, less than 25% of SDMs are engaged in the ACP process or aware of patient preferences, and often feel unprepared for decision-making. Koda is a machine-learning based ACP platform which offers dynamic educational content, decision guidance, and advanced directive documentation for patients and SDMs. Aims of this study are to: 1) determine motivators of patient-SDM alignment among Koda users and 2) develop a machine learning algorithm to perform SDM persona identification.

Participants will be 50 patient-SDM dyads. Eligible patients will be 50+ years of age, without dementia or blindness. SDMs will be 18+ years old. All participants should have an email address and ability to read and speak English. Following informed consent, patients will complete the Koda ACP platform and a survey about SDMs' values and experiences. SDMs will complete a self-survey and perceived alignment surveys before and after reviewing the patient's completed ACP. Survey data will be used to train theSDM persona detection algorithm. Dyads will also be invited to complete qualitative interviews, for further exploration of patient-SDM experiences.This pilot project aims to better understand patient-SDM alignments and to develop an algorithm for identification of SDM personas, with the ultimate goal of facilitating increasingly high-quality ACP and goal-concordant care.

https://www.kodahealthcare.com/

PennAITech YouTube Feature

University of Colorado
Anschutz Medical Campus

KAISER PERMANENTE®
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TITLE: LEVERAGING PATIENT PORTALS TO SUPPORT CAREGIVERS

Jennifer Portz, PhD

Caregivers for people living with dementia (PLWD) make up a diverse group of individuals and can include family, friends, and paid direct care workers. Nearly 30% of caregivers in the United States report caring for a PLWD. While providing care to a loved one can be rewarding, some caregivers may feel caregiver burden and become self-neglectful (e.g., eating poorly, poor exercise habits), which have the potential to lead to poor health outcomes among caregivers. Caregiver-specific interventions are beneficial for improving mental health, confidence in caregiving, and self-care. However, caregivers often experience barriers to such interventions such as time and access. The objective of this pilot is to develop a data-framework for finding caregivers from the electronic medical record (EMR) who can benefit from caregiver and dyadic interventions. PLWD and their caregivers often receive health care services within the same healthcare system and their data hosted within the same EMR. Our previous work found that health outcomes, such as hospitalization, for caregiver-PLWD dyads living in the same household are linked. However, our current model is limited to caregivers living in the same household, often spouses, who share health insurance. Natural language processing can fill this gap by analyzing unstructured EMR data to find patterns among caregivers that will allow us to further idenify non-traditional caregivers (e.g., friends, neighbors) and caregivers outside the home (e.g., adult children, extended family members). By automating the process of caregiver identification through the EMR, interventions can be more easily delivered to engage and support the caregiver.

SCHOOL OF INFORMATION
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TITLE: CONVERSATIONAL CARE TECHNOLOGIES

Robin Brewer, PhD

This project focuses on designing and developing conversational care technologies for older adults and their caregivers. In prior work, we surveyed informal caregivers and older adult care receivers to understand their care routines. Survey findings showed how nearly 20% of care partners used voice assistants in their homes, signaling an opportunity to extend research on older adults' conversational technology use to include care partners. Next, we conducted a diary study and interviews with caregivers and care receivers to investigate gaps in care interactions and conversations. We found that care receivers experienced more communication frustrations than caregivers and that older adult caregivers wanted more opportunities to influence their care routines.

In this project, we will use these findings to develop in-home conversational technologies that use prompts to structure care conversations between older adults and their caregivers.

We contribute a nuanced dyadic perspective to care relationships as most care research focuses solely on caregiver perspectives. We also extend conversational technology research beyond information seeking to include more social uses by developing conversational technology applications with mainstream voice technologies (e.g., Amazon Alexa) to support improved care relationships, social and emotional well-being, and quality of life.

https://robinbrewer.com/

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TITLE: DESIGNING USABLE TECHNOLOGIES FOR OLDER ADULTS VIA DATA-DRIVEN WHOLE-PERSON USER PERSONAS

Robin Austin, PhD, DNP

The long-term goal of this research led by Dr. Robin Austin at the University of Minnesota and her team is to improve health outcomes by combining whole-person patient-generated health data with EHR data, to inform clinical conversations, predict patient trajectories, and identify appropriate interventions. This research, Designing Usable Technologies for Older Adults via Data-Driven Whole-Person User Personas, will create a set of data-driven user personas based on data from 6 studies where 783 adults 65+ years old independently completed a comprehensive health assessment using the MyStrengths+MyHealth (MSMH) mobile app developed by Dr. Robin's team. MSMH assesses 42 strength/problem areas (e.g., Income, Spirituality, Nutrition) divided into four categories (e.g., My Living, My Mind and Networks, My Body, My Self- Care). Individuals can specify any of 335 challenges (e.g., Hard to concentrate) and any of 4 needs related to each strength/problem area (e.g., Check-ins, Hands-on Care, Info/Guidance, Care Coordination). We will use machine learning approaches, clustering analysis and association rule learning, which are frequently used to develop user personas. These whole-person user personas will account for a 360 degree view of the person, meaning the environments in which individuals live, their psychosocial and physical health needs, and their strengths. This research will inform person-centered technology design and develop a better understanding of the types of older adults who may use AI-based technologies.

https://nursing.umn.edu

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Perelman School of Medicine, University of Pennsylvania

Penn Frontotemporal Degeneration Center

TITLE: FEASIBILITY OF DIGITAL MONITORING TO DETECT AUTONOMIC MARKERS OF EMPATHY LOSS IN BV FTD

Emma Rhodes, PhD

Loss of empathy is a core symptom of behavioral variant frontotemporal dementia (bvFTD) that negatively impacts daily functioning and is highly distressing to families and caregivers. Scientific research has struggled to understand the specific causes of empathy loss in bvFTD. A relatively unexplored but promising avenue of scientific inquiry is the role of autonomic nervous system (ANS) arousal in empathy loss in bvFTD. The ANS is comprised of two complementary subsystems, the sympathetic and parasympathetic nervous systems, which operate together to regulate an individual's level of physiologic arousal in response to emotional cues from the environment. Patients with bvFTD show abnormalities in autonomic arousal that are linked to symptoms of social dysfunction, including loss of empathy, but this line of research has been hindered by reliance on traditional methods of measuring autonomic arousal, namely hard-wired EKG and skin conductance sensors, which restrict the movement of the patient and are sensitive to motion effects. Recent advances in wearable smartwatch technology allow for precise, unobtrusive measurement of autonomic arousal with built-in motion sensors that more accurately capture key arousal variables, such as respiratory sinus arrythmia and skin conductance. Use of smartwatch technology will advance our understanding of physiologic mechanisms of empathy loss in bvFTD and other neuropsychiatric symptoms in ADRD and identify potential treatment targets. The overarching goal of this project is to test the feasibility of using a smartwatch to capture abnormalities in autonomic arousal in bvFTD and validate digital markers of autonomic abnormalities against behavioral measures of empathy loss.

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https://www.med.upenn.edu/ftd/

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USC Viterbi
School of Engineering

TITLE: AN ACCESSIBLE MACHINE LEARNING-BASED ADRD SCREENING TOOL FOR FAMILIES AND CAREGIVERS

Maja Matarić, PhD

The goal of this project is to develop an app-based screening system capable of detecting early signs of Alzheimer's Disease (AD) using data captured during sessions of standard clinical AD diagnostics. Approximately 50 million people worldwide are diagnosed with dementia. As of 2021, an estimated 6.2 million Americans, one in nine people 65 and older, are living with AD.The majority of affected people do not obtain early screening toward a timely dementia diagnosis. Consequently, there is a large and rapidly growing need for low-cost, non-invasive, and accessible tools for dementia screening toward alerting families and caregivers and encouraging them to pursue medical evaluation. The proposed app is intended for family members and caregivers and will be designed to be easy to use and encourage regular screening. The goal is for the proposed app to enable convenient early flagging of AD for the general public.

https://maja-mataric.web.app/

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Weill Cornell Medicine

TITLE: DETECTING RESPIRATORY DISTRESS IN PATIENTS WITH ADVANCED ADRD USING RADIO SENSORS

Veerawat Phongtankuel, MD, MS

This project focuses on designing and developing conversational care technologies for older adults and their caregivers. In prior work, we surveyed informal caregivers and older adult care receivers to understand their care routines. Survey findings showed how nearly 20% of care partners used voice assistants in their homes, signaling an opportunity to extend research on older adults' conversational technology use to include care partners. Next, we conducted a diary study and interviews with caregivers and care receivers to investigate gaps in care interactions and conversations. We found that care receivers experienced more communication frustrations than caregivers and that older adult caregivers wanted more opportunities to influence their care routines.

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https://weill.cornell.edu/

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