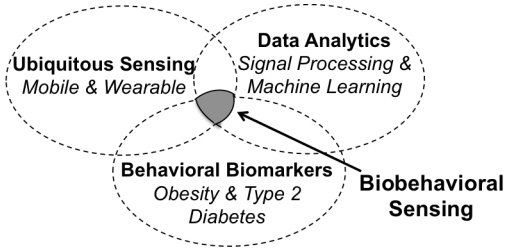
According to the Center for Disease Control (CDC), health-risk behaviors are the leading cause of chronic conditions, disabilities, and deaths amongst adults and youth. The jarring fact underlying this finding is that these unhealthy behaviors are amendable and preventable, therefore making related chronic conditions and disabilities preventable. This grand challenge motivates my work in the exciting and emerging research area of *biobehavioral sensing,* with the aim to develop novel sensor methods for ubiquitous monitoring of physiological and behavioral markers relevant to monitor, predict, and improve human health (Fig. 1). My research vision is two-part: 1) equip medical practitioners with quantitative data from ubiquitous sensors to augment treatment plans, and 2) equip people with personalized data-driven knowledge to inform improved behavioral habits that can positively influence health outcomes.



Research Projects
- Digital T2D – Learning Digital Behavioral Markers of Type 2 Diabetes (2017 - Present)
- Sensor-based Dietary Monitoring (2013 – Present)
- Smartphone Based Evaluation of Sociability & Affective State (2016 – Present)
- BioZ Sense & WeightAware (2016 – 2017)
- Medication Adherence Monitoring (2012)
- Assistive Technology – Tongue Drive System (2010)

Fig. 1: My Research Area and Projects

In my future tenure-track faculty role, I plan to establish the **Healthy-Living Technology Laboratory (HLT-Lab)**. The mission of HLT-Lab is to work closely with medical and psychology teams to develop technology that enables sustained healthy behavior choices for improved living. My research lab will focus on three primary goals, namely: 1) integrate multimodal sensors in wearable, mobile, and environmental systems to collect and analyze personalized behavioral and physiological data, 2) develop intelligent machine learning and data analysis models to extract relevant information from continuous sensor data, 3) validate and translate clinically-targeted sensor-based solutions to defined user subsets. My previous and ongoing research on leveraging mobile technology to quantitatively inform type 2 diabetes interventions, sensor-based dietary monitoring, medication adherence, affective monitoring, and assistive technology have equipped me with skillsets to lead the envisioned HLT-lab.

In my first two years as a tenure-track faculty, I will focus on three research directions: 1) my newly proposed project titled *Digital T2D,* currently under review for an NIH Early Independence Award, 2) continued research on my Ph.D. topic – *Sensor-based Dietary Monitoring*, and 3) an ongoing and related research project with colleagues in my department or institution at large. Each of these research directions will enable me to start my independent career working with and learning from an interdisciplinary team of seasoned clinical, behavioral, and engineering personnel. Additionally, I will submit a revised and/or extended proposal to the NIH K25 Mentored Quantitative Research Career Development Award. This proposal application will build on my knowledge from partaking in a semester-long grant writing seminar at Rice University (Spring 2017), my current *Digital T2D* grant application, as well as my skillset from securing the 2012 Achievement Rewards for College Scientists (ARCS) and 2013 National Science Foundation (NSF) - Graduate Research Fellowships.

I believe that an academic career in research and teaching is a high calling because it has the potential to positively influence current and future generations. My passion is to use technology to equip individuals with personalized health knowledge to inform improved lifestyle decision-making. I can only success in this vision at an institution and department that portrays diversity in people, thought, and research to leave a lasting impact on our society's health status.

Selected Research Experience

Diversity in my research training has prepared me from my next step as tenure-track faculty in electrical engineering and/or computer science. I have had exceptional training at top universities including the University of Texas at Austin for undergraduate studies, Georgia Institute of Technology for doctoral studies (Advisors: Maysam Ghovanloo and Elliot Moore), and Rice University for postdoctoral training (Advisors: Ashutosh Sabharwal and Ashok Veeraraghavan). During these experiences, I have gained requisite competencies in planning and executing interdisciplinary research (5 of which are described below), mentoring junior researchers (total of 6), teaching and guest lecturing in engineering courses (total of 3 courses) and grant writing to become successful in the field of biobehavioral sensing research. Additionally, I have and continue to make it a priority to actively participate in my research community. Thus far, I have presented my research at 4 invited talks and served as a reviewer for the International Global Conference on Signal and Information Processing (GlobalSIP 2017), International Conference on Biomedical Device and Electronics (BIODEVICES 2017), and IEEE Biomedical Circuits & Systems Conference (BioCAS 2015). The rest of this section describes in more details 5 key research projects that are exemplary of my strong technical training and passion for biobehavioral sensing research.

1. **Digital T2D – Learning Digital Behavioral Markers of Type 2 Diabetes**: I recently completed and submitted my first NIH grant application as principal investigator in collaboration with experts in data science, obesity and type 2 diabetes, behavioral and nutritional science at Rice University and Baylor College of Medicine. Digital T2D aims to investigate digital behavioral markers associated with the increased risk of Type 2 Diabetes (T2D) in young adults (18 – 34 yrs.) to objectively inform tailored lifestyle interventions. This targeted group of young adults with an increased risk for T2D and associated neurological, cardiovascular, and renal complications presents a major opportunity for high-return interventions that can prolong their life expectancy. Motivated by a lack of quantitative data, two pervasive questions in primary care are: 1) what to focus on in the limited time of clinical encounter?, 2) what interventions have the highest probability for success in specific patients. These questions drive the primary hypothesis that objective digital data of individuals with increased risk of T2D can inform tailored interventions to achieve higher adherence and improve health outcomes in pragmatic, real-world settings. Digital T2D uses passively harnessed mobile data to quantify digital footprints relevant to clinical interventions for preventing and reducing T2D. I am actively collecting pilot data using a custom developed mobile-software to passively gather lifestyle-related data such as mobility, locations visited, and sleep for algorithmic learning of T2D behavioral markers.
2. **Sensor-based Dietary Monitoring**: The bulk of my research work has focused on the growing field of automatic dietary monitoring in unconstrained environments [1-6]. Unhealthy dietary behavior affects all ages, genders, and demographics, and is associated with obesity, diabetes and other chronic conditions. Existing self-report methods are prone to gross inaccuracies and not fit for long-term use. My Ph.D. research focused on acoustic systems for quantitative monitoring of dietary activities, primarily chewing and swallowing. This work involved sensor integration and algorithm development for real-time swallowing detection [1], tracheal activity recognition and classification [2], and detecting chewing events in noisy acoustic signals [3]. In addition, I wrote a comprehensive review paper [4] to highlight the pros and cons of unique sensor-based approaches and machine learning

methods for automatic dietary monitoring. A primary accomplishment of this review paper is the identification of key issues, challenges and gaps to motivate future work. My continued postdoctoral research projects (*BioZ Sense* and *WeightAware*) aim to address two identified gaps, namely: 1) sensor-based monitoring of clinically relevant dietary biomarkers, and 2) targeted dietary monitoring systems for unique populations such as persons with diabetes.

3. **BioZ Sense:** This project aims to evaluate the relevance of an unexplored and potentially promising sensing mechanism, bioimpedance, for continuous health monitoring in daily living. Bioimpedance sensing is particularly promising because it allows external sensing of internal variations in the human body. The central hypothesis of this project is that aspects of dietary behavior such as water and sodium intake can be monitored non-invasively through continuous impedance sensing of variations in the body's electrolyte-water balance. This project was in collaboration with the Body Composition Laboratory at Children's Nutrition Research Center - Baylor College of Medicine.
4. **Smart-phone Usage Based Evaluation of Sociability and Affective State**: In today's society, there is no effective method to automatically and continuously track a patient's mental health status. The gold standard for assessing a psychological disorder depends on clinical interviews and self-report data that do not take into account behavioral habits in daily living. In collaboration with Baylor College of Medicine, we have developed a mobile application and backend cloud platform for data collection and storage of digital footprints associated with affective state. We collect three types of data from clinically depressed patients: (i) smartphone sensor and usage data such as location, steps, screen status, call log, text messaging, and application use, (ii) daily self-reported mood and activity level, and (iii) psychometric data from bi-weekly in-clinic exams, including PHQ-9 (Patient Health Questionnaire) and HamiltonD (Hamilton Rating Scale for Depression). Our pilot study shows a correlation between smartphone sensor data (step count, number of text messages, and time spent messaging) and psychometric scores. My current work on this project includes modeling passively harnessed digital data from a teenager-focused clinical trial. Our research seeks to further findings from previous work and support on-time interventions by evaluating smartphone-harnessed data from actual patients to assess the correlation and severity of the mental disorders.
5. **Assistive Technology - Tongue Drive System**: This project aims to provide quadriplegics with an unobtrusive assistive technology for independent tongue-control of their wheelchair, and computer-access. My research involved quantitative performance evaluation of the tongue drive system against other computer-access assistive devices such as sip-n-puff, voice-control, and eye-tracker. This evaluation served as a building block for validating the tongue drive system in clinical trials.

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Selected Publications:

[1] T. Olubanjo et al., *IEEE ICASSP* 2014. [2] T. Olubanjo et al., *IEEE EMBC* 2014 **(Best Student Paper)**. [3] T. Olubanjo et al., *IEEE BHI* 2016. [4] T. Prioleau et al., *IEEE TBME* 2017. [5] T. Prioleau et al., *IEEE BHI 2017*. [6] T. Prioleau et al., 2017, *In Preparation*.