Alzheimer's Behavior-learning Cognitive System

In 2015, Apple announced the Apple watch program of cooperating with university and research organizations on ResearchKit and HealthKit. Since then, it has been helping researchers and doctors producing medical insights and discoveries at a pace and scale that has never been seen before. Current wearable devices and consumer products are not in the level yet to make a significant influence on Alzheimer disease, but it provides a great technology foundation and leads us in a new path for curing Alzheimer's. The system we are proposing at this paper, "Alzheimer's Behavior-learning Cognitive System (ABCS)" is a behavior learning-based intelligent system for Alzheimer's detection, diagnosis, and treatment.

Alzheimer's is officially listed as the 6th leading cause of death in the US. Since the year of 2000, all 5 other causes have been to some extent controlled or decreased, except for Alzheimer's, with a 125% increase, and this number is continually increasing as the aging population. Each individual patients care cost $340,000, the cumulative total cost of medical and long-term care expenditures for all individuals in the US is $47.1 trillion. Even with this much of cost, not much we can do besides patients caregiving. We don't have any medicine on cure Alzheimer's. The latest research shows that 20 or more years before symptoms appear, brain changes associated with Alzheimer's disease may begin. It is important to discover and diagnoses early.

In the short term, the aim of ABCS is to intelligently detect the behavior difference, predict the progression of Alzheimer's patients and provide the early diagnosis. In the long term, by the causality analysis, we will have a better understanding of risk factors, how the outside of the environment affecting the inside of our brain, change the direction before the trigger of Alzheimer's happens, and eventually, delay the trigger time.

ABCS is a deep learning based system with the purpose of learning the behavior of patients and their cognitions based on the environment. It collects data from patients and potential patients in preclinical and Mild Cognitive Impairment (MCI) stage before showing any symptoms, as well as sever stage. It converts the various medical request into different configurations in data collection settings.

For patients and potential patients, it serves as an invisible assistant to observe the behavior and synchronizes captured data to doctors; for researchers, it provides a much richer level of research data for clinical trials and another purpose. It is the gateway among the research

center, doctors, and patients. It collects data of accelerometers, GPS, thermal, heartbeat, and NLP and many other behaviors. It is a customized solution that cognitively adjusts its goals for each individual patient and non-patient.

Why would this solution make a difference? A lot of the research from inside of the brain has been done. However, Alzheimer's is an interaction between in-brain activity and the outside world, and the interaction is presented by patients behavior, including physical behavior and language. Monitoring and analysis of the behavior is a key component to understand this interaction.

In Preclinical and MCI stage, most of the time it is not noticeable by patients or their families. Based on the embed deep learning algorithm, ABCS has the advantages of detecting Alzheimer's in the unnoticeable stage. Many researchers believe that future treatments to slow or stop the progression of Alzheimer's disease and preserve brain function will be most effective when administered early in the disease process. In ABCS, we are using behavior learning combined with a biomarker to achieve two goals, early diagnosis, and progression tracking. ABCS also enables researchers to identify which individuals to enroll in clinical trials of potential new therapies.

Turing test has been the standard for AI assessment, we can use verbal interaction to determine whether the AI has reached a certain level, here we can match the patient's' behavior data to determine the stage of patients Alzheimer's and predict the progressions.

With the deep level data that is collected by ABCS, a more thorough causality analysis is made in the system. Family history, age, lifestyle, education level, high blood pressure, high cholesterol, head injury, environmental toxins have been discovered as risk factors for Alzheimer's in various research, but we haven't been able to make too much progression on understanding the cross affection among the factors. ABCS provides more accurate data to generate the topology of the relationship. Combining certain factors of the risk factors as a trigger event, we are able to prevent or delay the trigger event by altering the combination. Doctors can use ABCS to evaluate the risk and to provide optimal treatment plans.