Commentary on paper [P4] Asif Salekin

[P4] Fatih Altay, Guillermo Ramón Sánchez, Yanli James, Stephen V. Faraone, Senem Velipasalar, **Asif Salekin**. Preclinical Stage Alzheimer's Disease Detection Using Magnetic Resonance Image Scans, The Thirty-Third Annual Conference on Innovative Applications of Artificial Intelligence (IAAI), 2021. https://doi.org/10.1609/aaai.v35i17.17772

Problem and Motivation: Alzheimer's is a type of brain disease mostly seen in older age and starts without showing any symptoms. It is still not clear when or how AD begins. To fully understand the effects of AD, it is important to investigate the disease since its beginning. There are three stages of AD known today. The first stage is referred to as the preclinical stage, which is the main focus of this work. The preclinical stage is when neurons start degenerating, even if there are no visible symptoms. Notably, detecting Alzheimer's disease in its early stages (i.e., Preclinical), even if there are no visible symptoms, is an important task, especially when the potential benefits on human life and the economy is considered. In this paper, we propose two attention models for detecting Alzheimer's disease, in the earliest (preclinical) stage, from 3D MRI images.

Paper's Novelty and Contribution: Magnetic resonance imaging (MRI) of the brain produces detailed 3-dimensional (3D) images of the brain. MRI imaging has allowed doctors and researchers to investigate brain structure and brain-related diseases and has been leveraged by recent AI and deep-learning-based studies. One of the main differences between our proposed approach and the existing studies is that prior works address the detection of Alzheimer's disease in the second and third stages when the effects and symptoms of the disease and the changes in brain neurons are identifiable. However, the detection of preclinical AD (first stage) is one of the important goals for the medical community. Thus, we have focused on and developed a novel method for detecting AD in the first (preclinical) stage, even when there are no visible symptoms. Notably, we developed attention-based mechanisms by leveraging transformer and 3D recurrent visual attention models. Hence, the resulting approach can visualize the brain regions indicative of preclinical AD, which is significant for practical use by the medical community. According to our extensive evaluations, the developed approach can detect Preclinical AD about 8-12 years before any perceivable symptoms by the patient.

Professional Significance: The paper was published in the csranking.org listed top conference IAAI 2021. I was the corresponding author. The paper was co-first authored by a master's student Guillermo Ramón Sánchez and a Ph.D. student Fatih Altay, under my mentorship. Notably, the paper received the prestigious '**IAAI Deployed Application Award**' at the IAAI conference.