MemSpark: Artificially Intelligent Virtual Reality System for Non-Intrusive Therapy and Evaluation of Dementia

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Dementia will become an epidemic with projected growth from 55 million to 153 million in 2050. Despite such severity, mainstream pharmacological and alternative therapies such as acetylcholinesterase inhibitors and reminiscence therapy fail to affect progression as most are symptomatic, invasive, or ineffective. This research develops an automated end-to-end system that creates a novel brain-training therapy using virtual reality and tracks dementia progression through artificial intelligence. Eight serious games were designed to exercise all cognitive functions by considering a set of promotive factors (immersion, confidence, focus) and preventive factors (anxiety, frustration, self-pity). Improvements in cognition were measured using three behavioral biomarkers: recall, reasoning, and executive function. Two features: accuracy and time, were extracted from each game and inputted into a neural network to produce dementia profiles aligned to the ADAS-Cog test. The therapy was tested weekly across 14 people with dementia (PwD): 10 experimental and 4 control, over five months, and the profiler was optimized both structurally and parametrically using homogeneous multi-model transfer learning along with other techniques on over 200 PwD's data to achieve an accuracy of 96.18%. Relative to the control group, the experimental group showed a slower rate of deterioration ($p = 0.05$). Based on the Prolonged Life Expectancy metric, this solution could double the time PwD have until they reach significant cognitive impairment. This solution can replace mainstream therapies (performed better than tDCS and CCT) and eliminate dependency on dementia profilers: enabling in-home care, and reducing care costs from $69,000 to $20,000 per year.

Awards Won:

Fourth Award of $500

Central Intelligence Agency: First Award: $1000 award

Association for Computing Machinery: First Award of $4,000