3rd National Conference on Enhancement in Biomedical Engineering and Healthcare
Organised by Department of Biomedical Engineering,
Adhiyamaan College of Engineering, Hosur, Tamil Nadu, India

COGNOFIT - A Game for Cognitive Impaired Patients: A Prelim Study

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ABSTRACT

People with permanent cognitive impairment need to be frequently assessed and monitored. There exists a various number of clinically validated cognitive assessment tools, but they need to be administered by the therapists in clinical settings often. This serves as a major barrier for frequent monitoring of cognitive function. In this proposed work, we introduce COGNOFIT a collection of innovative mobile games that allows one to self-administer the assessment of their cognitive function. The game performance is analyzed and thus converted into a clinical-accepted measure of cognitive function, specifically the Mini Mental State Examination (MMSE) score, improving the impact of the system in real-world clinical settings. To validate the feasibility of the approach, we will collect game-specific performance data from patients, which will be used to train a supervised machine learning model to estimate the corresponding MMSE score.
Keywords : Cognitive Impairment, MMSE, MMSE Score, Mobile Games.

I. INTRODUCTION

Number of people with permanent cognitive disabilities is increasing due to the trend of aging society . For these individuals, it is important to evaluate and track their cognitive functional/impairment level, which is often done using clinically validated assessment tools, such as the Mini Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) test. Unfortunately, these tests need to be performed under the supervision of trained staff in clinical settings.

The constraint of requiring the presence of a trained clinical physician during the assessment sessions, various approaches have been studied, including administering the conventional assessment tools, and self-administered computer-based or mobile-device assessments [8], [9]. The cognitive assessment tools have great potential to enable patient-centered care by monitoring individual-level out comes over time inpatients own environments [9]. Brandt et al. devised a new technique that can be administered by trained physician over the phone, so the assessments can be made easily [6]. Similarly, recent work by Absolahi et al. demonstrated the feasibility of administrating the MoCA through video conferencing [7]. Although these approaches enable frequent, remote assessment of the patients, they still require the presence of trained physicians and have minimal impact on the optimal utilization of the resources. There have been a lot attempts to enable self-administered cognitive assessments using computers or smart mobile devices [9], but they stop short , at reporting software-specified assessment scores rather than widely accepted assessment scores, such as MMSE or MoCA. This poses a significant limitation, and it is necessary for physicians to undergo

additional training to interpret their results along with the scores.

In this, we introduce COGNOFIT, that will be specifically to challenge and measure confound cognitive function in patients. We further propose a supervised machine learning approach that can translate the gaming-specific performance features that were extracted from the patients' engagement with COGNOFIT, to the MMSE score directly. The performance of the proposed system will be evaluated based on the data collected from the patients with cognitive impairment who will visit the clinic the results and the proposed approach can be self-administered by patients and accurately estimate MMSE scores, opening up new possibilities to assess cognitive function and their impairment.

II. LITERATURE SURVEY

Hwee-Xian (2018) proposed a technique for IoT based cognitive impairment administering results in the gradual decline in a person's cognitive abilities, and subsequently an increased risk of developing dementia.Timely medical and clinical interventions can be administered to elderly people who have been diagnosed with the MCI, to decelerate the process of further cognitive declines. Multi-modal sensors are placed in the residences of elderly, to monitor their Activities of Daily Living (ADL), as well as to detect signs of forgetfulness, Early results are potentially pick up signs of early cognitive decline in the elderly.[1].

Kyle Leduc-McNiven- identifies the mild cognitive impairment (MCI) and subtle changes to cognitive abilities that need therapeutic treatment programs. Two games are been developed. War CAT is based on the familiar card game, War, and "Lock Picking" is a optimal score search, akin to finding the combination that opens up a lock. Both games provide players with the immediate feedback but engage in different algorithms and heuristics to solve the respective problems at hand. They employ machine learning methods to detect subtle changes in an individual's cognitive processes over time [2].

Bing wang (2016), presented software toolkit is presented to identify mild cognitive impairment conversion, an early stage of Alzheimer's disease, from medical images. This toolkit extracts effective features from medical images,i.e., magnetic Resonance Imaging and position emissiontomography, to infer whether the patients in the stage of mild cognitive impairment convert to Alzheimer's disease or not. [3].

P. Garda Baez et al, (2015) proposed a assist in a CPN based system using a combination of neuro-psychological scales and some modifying factors. They presentedthe preliminary results exploiting the public ADNI dataset. This system is embodied in a clinical virtual environment, EDEVITALZH, provide an e-health solution for diagnosis of MCI, AD and other dementias. EDEVITALZH guides through their workflow and aids in diagnosis, prognosis and follow-up tasks. [4].

Shohei Katoet al,(2013)provided computer aided diagnosis for dementia, they developed a non-invasive screening system of the elderly with cognitive impairment. The system was constructed by SPCIR (Speech Prosody-Based Cognitive Impairment Rating) based cutoff as the 1st screening, and, as the 2nd screening, two-phase Bayesian classifier for discriminating among elderly individuals with these three clinical groups: elderly individuals with a normal cognitive abilities (NC), patients with a mild cognitive impairment (MCI), and an Alzheimer's disease (AD). Paper also reports the screening

examination and discrimination performance of the system for early detection of cognitive impairment in elderly subjects. [5].

Dmytro Domashenko(2017), proposed experiment for analyzing MRI images of the brain of patients with Alzheimer's disease (AD), mild cognitive impairment (MCI) and normal control (NC). new methods of extracting features from MRI images and selecting the most relevant features. The values of cortical thickness in regions of interest are used as features for MRI images. . The results of this paper are used for building a classifier in space of selected features. [6].

Tanaka Osamu et al,(2014), proposed Caregiving for a person suffering from dementia or loss of brain cognitive ability due to aging. A system for assisting caregivers at home. The system monitor the patient; assess possible risks ; and alert the caregiver on emergency by delivering video, audio and text to his mobile phone or PC. The technologies applied for sensing, communication, assessment and user-interface, and presented a prototype system implementation. [7].

III. CONCLUSION

In the proposed system a novel means to accurately estimate and analyze the clinically validated cognitive assessment scores that can be self-administered with or without the supervision of trained physicians. A collection of mobile games will be developed, COGNOFIT, and that can translate game performance into the MMSE score using different machine learning algorithm. The results will be obtained from individuals with mild cognitive impairments shows that the approach can accurately estimate the MMSE score .The proposed system has the potential to allow the patients to self evaluate themselves without any supervision of any trained physicians. Which will be more convenient and user engaging activity through a series of mobile games.

IV. IV. FUTURE SCOPE

As far as now we try to developed only two mobile games for self-evaluation of cognitive impairment. Games for selective attention, sequential memory, vigilance memory, visual investigation are yet to be developed. And the scores will be further sent to the doctor’s desk as the assessment is complete.

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Cite this article as :

Anu Priya. K, "COGNOFIT - A Game for Cognitive Impaired Patients: A Prelim Study ", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 5 Issue 5, pp. 01-04, March-April 2020.
Journal URL : http://ijsrst.com/EBHAC001