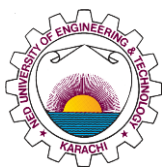




Final Year Project Showcase Batch 2020 Year 2024

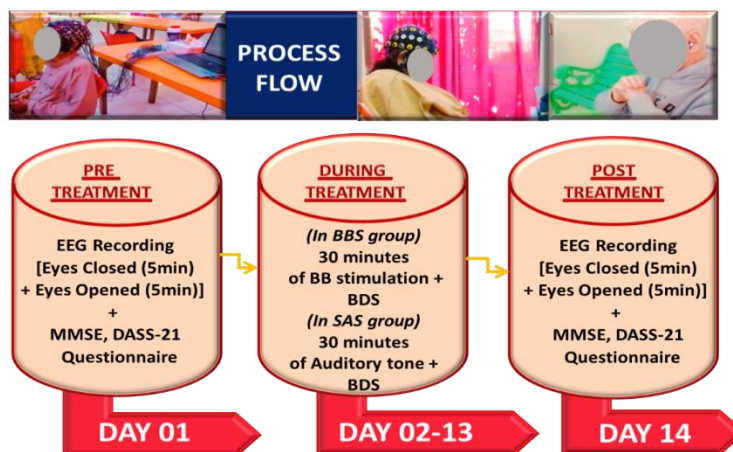
Department: Biomedical Engineering Programme: Biomedical Engineering	
1	Project Title Enhancement of Working Memory in Alzheimer’s Patients: A Neuromodulatory Approach
2	Project Idea The study aims to analyze the impact of Binaural beats (BB) stimulation in Alzheimer’s Disease (AD) patients for enhancing their working memory (WM) by applying various advance signal processing techniques and analyzing the deep cortical structures and neural networks of brain dynamics.
3	Process The study recruited 25 AD participants including 16 males, 9 females (69.96 ± 8.66 years old), which were divided into two groups: Experimental (n=15) and Control (n=10), based on the randomization control trial (RCT) criteria. The experimental group was provided with BB stimulation (Left ear: 400Hz, Right ear: 410Hz), whereas the control group received Standard Auditory stimulation (400Hz in both ears). The influence of the intervention was analyzed through behavioural and neurological assessments. Behavioural test entails, MMSE, DASS-21, and BDS questionnaire. However, neurological assessments were done through distinct signal processing techniques including, Power spectral density (PSD), Pearson’s Correlation between PSD & MMSE and PSD & DASS-21, Imaginary Coherence, Functional Connectivity, and Graph Theory Metrics, followed by the statistical analysis and 2-way ANOVA. Furthermore, the deep structural analysis was carried out through use of sophisticated software, sLORETA to visualize the significant impact of BB stimulation.
4	Outcome The outcomes of the study reveals the significant impact of BB stimulation on improving the neuropsychological and cognitive abilities in AD. The results of the behavioural test show a positive impact of BB, by illustrating a decline in stress, depression and BDS scores, followed by the increase in recalling, attention and language skills. Furthermore, the outcomes of connectivity, correlation, and graph theory networks portray significant increases in theta and alpha bands, which are associated with working memory. Moreover, the results of sLORETA signifies the enhancement of neural activity and strengthening of brain networks particularly associated with the memory in the experimental group, which provides further support to the results.
5	Evidence (Theoretical Basis) The outcome of the behavioral and neurological assessment reveals changes in the Theta band of experimental group which is associated with working memory enhancement. This group showcased significant power spectral density in theta band. It also exhibited strong functional connectivity in both theta and alpha bands, along with a significant enhancement in the information network dynamics, highlighting the efficacy of BB stimulation. Additionally, the experimental group also showed a strong positive correlation in the theta band, further indicating the beneficial effects of BB stimulation. Furthermore, the neural



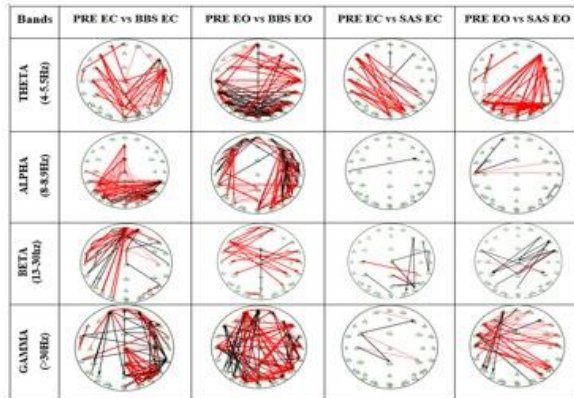
	network findings from the sLORETA also reveals the strong connections in the experimental group in comparison to the control group. These findings suggest that BB stimulation could be effectively implemented in clinical settings, offering a promising approach to enhance cognitive function in Alzheimer's patients.
6	<p>Impact on Sustainability of Urban Regions or SDG-11 "Sustainable Cities and Communities"</p> <p>It is a non-Invasive and cost effective intervention which may reduce the dependency of AD patients on pharmacological medications and treatments.</p>
7	<p>Competitive Advantage or Unique Selling Proposition</p> <p>(Cost Reduction, Process improvement, Attainment of any SDG (Sustainable Development Goal), increase of market share or capturing new market or having superior performance over a competitor. In summary, any striking aspect of the project that compels the industry to invest in FYP or purchase it. Some detailed description is required in terms of how, why when what. You can select one or more from the following dropdown and delete the rest of them). Please keep relevant options, delete the rest of them, and correct the sequence</p>
a	<p>Attainment of any SDG (e.g. How it is achieved and why it is necessary for the region)</p> <p>SDG#3, Good health and well-being: It ensures healthy lifestyle in AD patients by enhancing their cognitive abilities and emotional well-being.</p> <p>SDG#17, Partnerships for the Goals Collaborations with organizations to access patient data, which was essential for our research. Future partnerships with hospitals and the health sector to implement our interventions in clinical settings.</p>
b	<p>Environmental Aspect (e.g. carbon reduction, energy-efficient, etc.)</p> <p>The non-pharmacological nature of BB supports environmental sustainability in contrasts with some pharmaceutical interventions that necessitate resource-intensive production processes and produce hazardous waste.</p>
c	<p>Cost Reduction of Existing Product</p> <p>BB stimulation offers cost effective treatment to AD patients as compared to traditional pharmaceutical treatments that are likely to be more cost-effective.</p>
d	<p>Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process (e.g. What is the issue is current process and what improvement you suggests)</p> <p>Further research is urged to evaluate the long term sustainable effects of Binaural Beats by including the analysis of prolonged follow-up durations. Moreover, the applications of Binaural Beats should be further explored by employing this technique on various other neurologically impaired individuals with different disorders such as Parkinson's disease. By doing so, the relevance of binaural beat stimulation as a non-pharmacological intervention can be validate, thus facilitating its incorporation into clinical practice.</p>
e	<p>Expanding of Market share (e.g. how it expand and what is the problem with the current market</p>

	The market share can expand by entailing counter-measures, such as budget-friendly and painless intervention, in our approach.	
f	Capture New Market (e.g. Niche market or unaddressed segment) It addresses the demanding need for non-pharmacological, cost effective and accessible interventions for AD patients.	
8	Target Market (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service Target market includes healthcare centers, Neuroscientists, AD patients' caretakers and families of AD patients in Pakistan and beyond.	
9	Team Members (Names along with email address)	Nayab Mubashir nm.nayab@gmail.com Mehak Fatima mehakfatima089@gmail.com Eman Shah Imran Imranemanshah468@gmail.com Nisha Nasir nishakhi2002@gmail.com
10	Supervisor Name (along with email address)	Dr. Muhammad Danish danishmujib@neduet.edu.pk Mujib

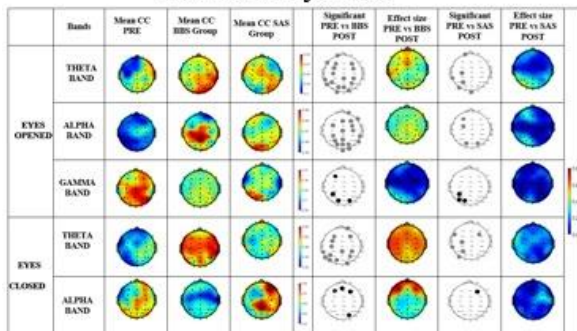
Picture#1 Experimental Protocols



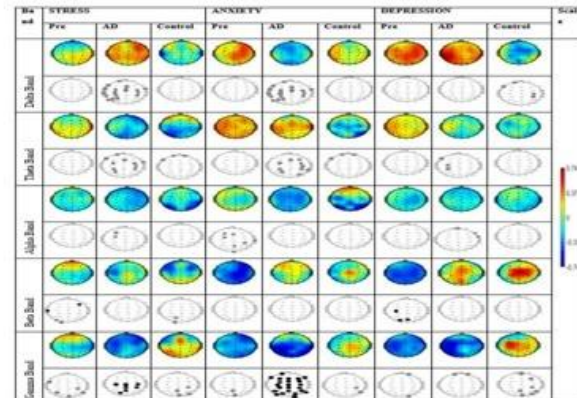
Picture#2 Results



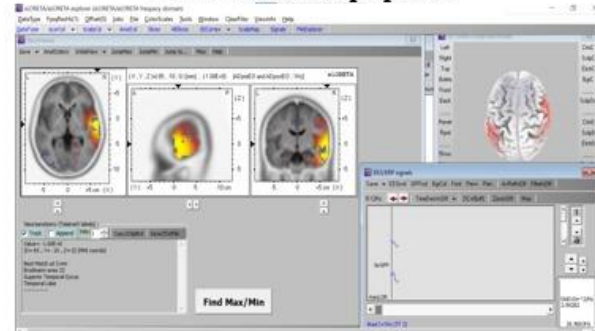
Connectivity Plots



Graph Theory Network



Correlation Topoplots



sLORETA