Department of Computer Science & Engineering

Pre-Final Year - Project Work Phase - 1 (21CSP67) - Abstract Submission

Academic Year 2023-24

1	Title of the Project	Enhancing Brain-Computer Interface (BCI) with Real-Time Neural Signal Decoding to Speech Conversion
2	Group No.	CS24
3	Department	Computer Science & Engineering
4	Project Area/Domain	Brain-Computer Interface, Neural Signal Processing & Speech Synthesis, Machine Learning
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6	Name of Guide	Dr. Mustafa Basthikodi

7. Abstract

Enhancing communication capabilities for individuals with speech impairments is a significant challenge in the medical and assistive technology fields. This project aims to develop an advanced Brain-Computer Interface (BCI) that translates real-time neural signals into spoken language, providing a novel communication method for individuals unable to speak due to conditions such as Amyotrophic Lateral Sclerosis (ALS) or severe brain injuries.

The key objectives of this project are to develop reliable methods for acquiring brain activity signals using Electroencephalography (EEG) or Magnetoencephalography (MEG), create advanced algorithms to accurately translate neural signals into phonetic representations with minimal latency, implement a natural-sounding speech synthesis system to convert these phonetic representations into spoken language, and design the system to adapt to individual users' neural patterns for improved accuracy and usability.

To achieve these objectives, the project requires EEG or MEG equipment for capturing neural signals, high-performance computing resources for data processing and model training, and software frameworks such as TensorFlow or PyTorch for developing and training models. Additionally, large, annotated datasets of paired neural signals and spoken language are essential for training the models, along with diverse speech datasets to ensure the system can generalize across different voices and languages.

The methodology involves recording neural activity using EEG or MEG devices while subjects speak or imagine speaking specific phrases, preprocessing the raw neural data to remove noise, extracting relevant features that correlate with speech components, and training machine learning models to map neural features to phonetic representations. These phonetic outputs are then converted into audible speech using a speech synthesis engine. The system is validated using separate test datasets to evaluate performance metrics such as accuracy, latency, and intelligibility, and the models are refined iteratively based on feedback.

This project aims to significantly improve the quality of life for individuals with speech impairments by leveraging advanced neural decoding and speech synthesis technologies. The

anticipated outcome is a robust, adaptable BCI system capable of providing real-time speech output from neural signals, thereby enhancing communication abilities and social interactions for those affected by severe communication disorders.

8.	**Signature of Students**	
9.	**Signature of Guide**	
10.	**Signature of the Project Coordinator**	