



Department of Computer Science & Engineering

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

Academic Year 2023-24

1	Title of the Project	Developing a Brain-Computer Interface framework for Real-Time Neural Signal Decoding and 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
5	Name of the Students with USN	1. Gagan V - 4SF21CS049 2. Misbah Zohar - 4SF21CS084 3. Neha P Achar - 4SF21CS096 4. Prateek Malagund - 4SF21CS109
6	Name of Guide	Dr. Mustafa Basthikodi



7. Abstract

Development of communication capabilities for individuals with speech impairments is a significant challenge in the medical and assistive technology fields. Brain-computer interfaces (BCIs) that reconstruct and synthesize speech using brain activity recorded with intracranial electrodes may pave the way toward novel communication interfaces for people who have lost their ability to speak, or who are at high risk of losing this ability, due to neurological disorders. 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), create advanced algorithms to accurately translate neural signals into phonetic representations with minimal latency, and then 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 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 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.

Keywords:

Brain-Computer Interface (BCI), Neural Signal Decoding, Speech Synthesis, Electroencephalography (EEG), Machine Learning, Signal Processing, Phonetic Translation, Assistive Technology, Communication Disorders

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