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| **Project Title**  **Integrating BCI and Machine Learning for Enhanced Robotic Arm Control**       |  |  |  | | --- | --- | --- | |  |  |  | |
| M. Yousaf Iqbal FA20-BCE-008  Moiz Usman FA20-BCE-025  Fazeel Abbas FA20-BCE-041  M. Naeem FA20-BCE-093  Project Advisor: Dr. Jehangir Arshad  SPRING 2023 |
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| **PROJECT ID** | | 017 | |  | **NUMBER OF MEMBERS** | 4 |
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| **TITLE** | Integrating BCI and Machine Learning for Enhanced Robotic Arm Control | | | | | |
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Abstract

This project seeks to improve the life of individuals with limb loss by using Brain-Computer Interface and Machine Learning algorithms to control robotic arm to perform daily tasks. Traditional robotic arms, relying on arm muscle signals or external switches, can’t be controlled if the individuals have limb loss. This novel approach helps individual to control robotic arm with their brain signals. BCI enables direct communication between the user's brain and the robotic arm by studying EEG signals from brain. Emotive EPOC+ Headset with 14 electrodes is used to capture the EEG signals. However, this Raw EEG data is full of noise and artifacts. For better application of BCI system, the ratio between noise and signals containing essential data matters a lot. Pre-processing of EEG signals is done via EEGLAB by MATLAB, which is a tool to process brain signals. EEGLAB offers filtering techniques such as baseline and clean-line were used to remove DC Amplitude in signals. Moreover, temporal filters such as High pass, low pass and band filter are used to acquire signals with require frequency (alpha and beta frequency bands) and spatial filters are used to eliminate unwanted channels. After Pre-processing the next step is Feature extraction. ICA technique is used to extract features and EEG Classification algorithms are used to map EEG signals onto machine commands. The classifier algorithms used for this purpose are Random Forest, KNN, Gradient Boosting, Logistic Regression, SVM. After classification of these EEG signals, Arduino UNO is used to convert these analog signals into meaningful commands to control robotic arm motors.