# NEURONAV: MIND CONTROLLED MOBILITY

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**Keywords:**

EEG-based, Emotive EPOC X, Wheelchair Control System, Virtual Environment, Brainwave Patterns, Unity Integration


**Introduction:**

The project aims on the development of an EEG-controlled wheelchair simulation system, integrating the Unity game engine for simulation and Python for backend processing. This work explores the feasibility and effectiveness of using Brain-Computer Interface (BCI) technology to control a wheelchair in a virtual environment.Our inspiration stemmed from the intersection of neuroscience and assistive technology. We were motivated by the potential of EEG technology, particularly the Emotiv Epoc X EEG headset and it's Cortex API, to empower individuals with motor disabilities.Before the development, an extensive research was conducted to understand EEG fundamentals, Unity game development, and Python programming. This groundwork prepared us for hardware setup, software integration, and prototype testing. Collaboration played a pivotal role in establishing clear objectives, delineating responsibilities, and formulating a development roadmap. We familiarized ourselves with the Emotiv Epoc X headset and Cortex API, drawing insights from existing EEG-based applications.

**Objectives:**

(a) This project integrates EEG technology into wheelchair controls via Unity and Python, focusing on interpreting signals from the Emotiv Epoc X headset for movement commands in a virtual environment. User experience is a key, with intuitive interfaces for accessibility.
(b) Rigorous testing refines accuracy and usability based on feedback.
(c) To facilitate independent movement for individuals with mobility challenges.
(d) To assess the influence of EEG-based control systems on the quality of life and autonomy of individuals with disabilities.

**Methodology**:

The methodology employed for developing the brain-controlled wheelchair system follows a systematic approach as below

Materials: The primary materials utilized include the Emotiv Epoc X EEG headset, Python for backend development, Unity for simulation, and various machine-learning libraries for model development.

Methods: The methodology is structured and iterative, beginning with data acquisition and preprocessing. EEG data is collected and preprocessed to enhance its quality, followed by the development of a machine learning model for EEG signal classification and interpretation using Python.

Details of Work Carried Out:

(a) Data Acquisition and Preprocessing: EEG data is collected and preprocessed to ensure high-quality input for analysis.
(b) Machine Learning Model Development: Python is used to construct and train a machine learning model for EEG signal classification.
(c) User Calibration and Training: A user-friendly calibration procedure is implemented to personalize the system based on individual user preferences.
(d) Real-time Command Execution: The system ensures real-time execution of wheelchair commands within the Unity simulation.
(e) Feedback and Monitoring: A feedback system provides users with real-time updates on system status and signal quality.

This meticulous approach ensures the creation of a robust and user-friendly brain-controlled wheelchair system that meets user needs and expectations.

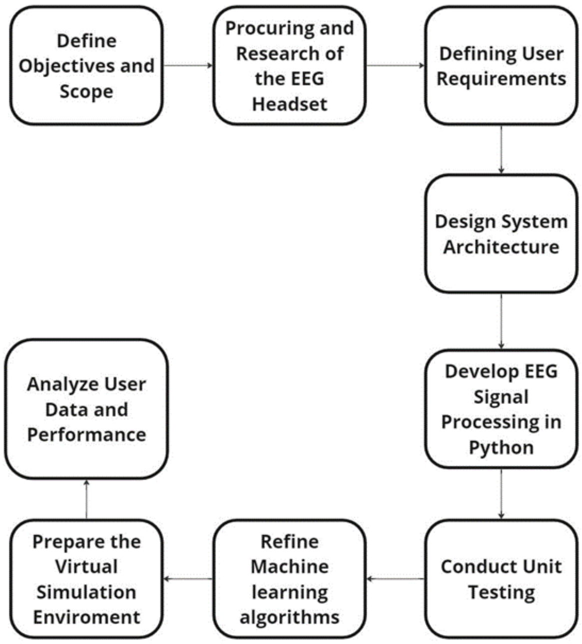
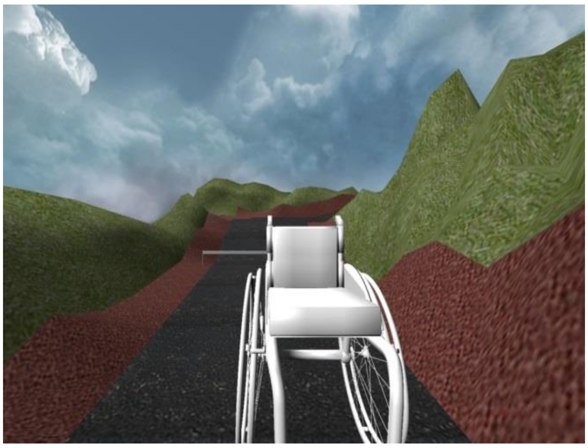



**Fig 1: Proposed Methodology**

**Conclusion:**

The results of the brain-controlled wheelchair project signify significant progress in the development of assistive technology for individuals with motor disabilities. Key findings from the work carried out include the successful completion of the simulation environment using Unity, streamlined Emotiv UI and headset setup, proficient EEG data processing and machine learning model development, and effective Unity simulation and interaction.The Emotiv UI simplifies the connection process, enhancing user engagement with the system. Initial tests utilizing the Emotiv SDK's capabilities demonstrate proficient signal capture and preprocessing, laying a solid foundation for machine learning model development. The fully developed Unity simulation enables users to navigate the virtual wheelchair with ease, showcasing the system's high level of responsiveness.

Graphical analysis using built-in Emotiv SDK graphs provides valuable insights into EEG signal characteristics. The completion of the simulation environment marks a significant milestone, setting the stage for future development efforts focused on machine learning model integration and system refinement.In conclusion, the results obtained signify promising progress towards the realization of a fully operational brain-controlled wheelchair system. The completion of key milestones and successful demonstration of foundational capabilities underscore the potential of this technology to improve mobility and enhance the quality of life for individuals with physical restrictions. Ongoing development efforts will continue to refine and optimize the system, advancing toward the ultimate goal of empowering users with seamless and intuitive control over their mobility devices.



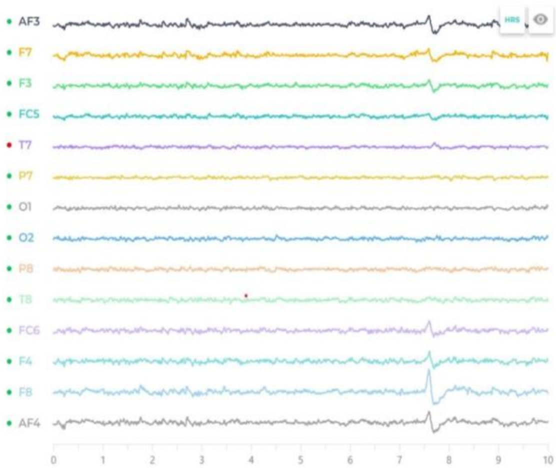



**Fig 2: Unity Implementation**

**Fig 3: Raw EEG Data Graph**

**Scope for future work:**

(a) The future scope of the brain-controlled wheelchair project encompasses several avenues for advancement:

(b) Advanced Machine Learning Techniques: Explore deep learning and reinforcement learning to enhance system accuracy and responsiveness.
(c) Enhanced User Interface: Develop intuitive controls and interactive elements to improve user engagement and accessibility.
(d) Real-time Feedback Mechanisms: Implement real-time feedback for users to assess system performance instantly.
(e) Real-world Testing: Conduct testing in clinical and home environments to validate system performance.
(f) Integration with External Devices: Incorporate environmental sensors and wearables for enhanced functionality and safety.
(g) Adaptive Navigation Algorithms: Develop algorithms to dynamically adjust wheelchair movement based on user intent and environmental conditions.
(h) Long-term User Adaptation: Implement personalized learning algorithms for continuous system refinement.
(i) AR/VR Integration: Explore AR/VR technologies to create immersive navigation environments.
(j) User Feedback and Iterative Design: Continuously gather user input to refine system design and functionality, ensuring it meets the diverse needs of individuals with motor disabilities.
(k) Industry Collaboration: Collaborate with partners to advance research, funding, and commercialization efforts.