Title

Brain controlled Human-Computer Interaction

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Contents

Introduction:

Human-Computer Interaction (HCI) has witnessed significant advancements in recent years, driven by the need for more intuitive and accessible interfaces. This literature review explores the emerging field of EEG and gyroscope-based hands-free mouse emulation systems, which promise to revolutionize HCI by enabling users to interact with computers and devices using their thoughts and head movements. These systems offer a potential breakthrough for individuals with physical disabilities and are gaining momentum in both research and practical applications.

Literature review:

EEG-Based Interfaces: Electroencephalography (EEG) has long been employed in brain-computer interface (BCI) research. EEG sensors placed on the scalp detect electrical activity associated with brain functions, allowing users to control devices through mental commands. Pioneering studies such as Farwell and Donchin (1988)[1] demonstrated the feasibility of using EEG for cursor control, laying the foundation for hands-free mouse emulation systems.

Gyroscope-Based Interfaces: Gyroscope sensors, on the other hand, have been widely used in various applications, including gaming and virtual reality. They measure angular velocity and orientation, making them suitable for capturing head movements. Researchers like Razak et al. (2019)[2] have explored the integration of gyroscopes for head-based cursor control, providing an alternative approach to traditional mouse input.

Hybrid Approaches: Recent developments have seen the convergence of EEG and gyroscope technologies to create hybrid systems (Ma et al., 2020)[3]. These systems offer improved accuracy and versatility, as they can harness the power of both mental commands and head movements for precise control.

Practical Applications: The potential applications of EEG and gyroscope-based hands-free mouse emulation systems are extensive. They can significantly enhance the quality of life for individuals with motor disabilities (Nijholt, 2019)[4] and find applications in gaming, healthcare, and assistive technology.

Challenges and Future Directions: While the promise of these systems is evident, several challenges remain, including signal noise, calibration issues, and user training (Huggins et al., 2015)[5]. Future research should focus on refining the technology, expanding the range of supported actions, and addressing user-specific needs and preferences

Problem Statement:

This project addresses this problem by designing a system that interprets gyroscope data and detects double-blinking events through EEG (Electroencephalography) signals, allowing users to control a computer mouse without physical contact.

Objectives:

The project's main objectives are as follows:

1. Develop a hands-free mouse emulation system using gyroscope data and EEG signals.
2. Implement Empirical Mode Decomposition (EMD) to process EEG signals, reducing noise caused by head movements.
3. Create a double-blinking detection mechanism for mouse clicks using EEG signals.
4. Utilize Kalman filtering as a state estimator for precise cursor movement and jitter removal.
5. Evaluate the system's performance in terms of detection accuracy and cursor control.

Methodology:

The project will follow these key steps:

Signal Acquisition:
EEG and gyroscope signals will be collected from the Emotive headset during user interactions.

Noise Reduction:
Empirical Mode Decomposition (EMD) will be applied to EEG signals to reduce noise caused by head movements. A correlation-based technique will identify common signals in multiple electrodes, helping distinguish artifacts from blinking signals.

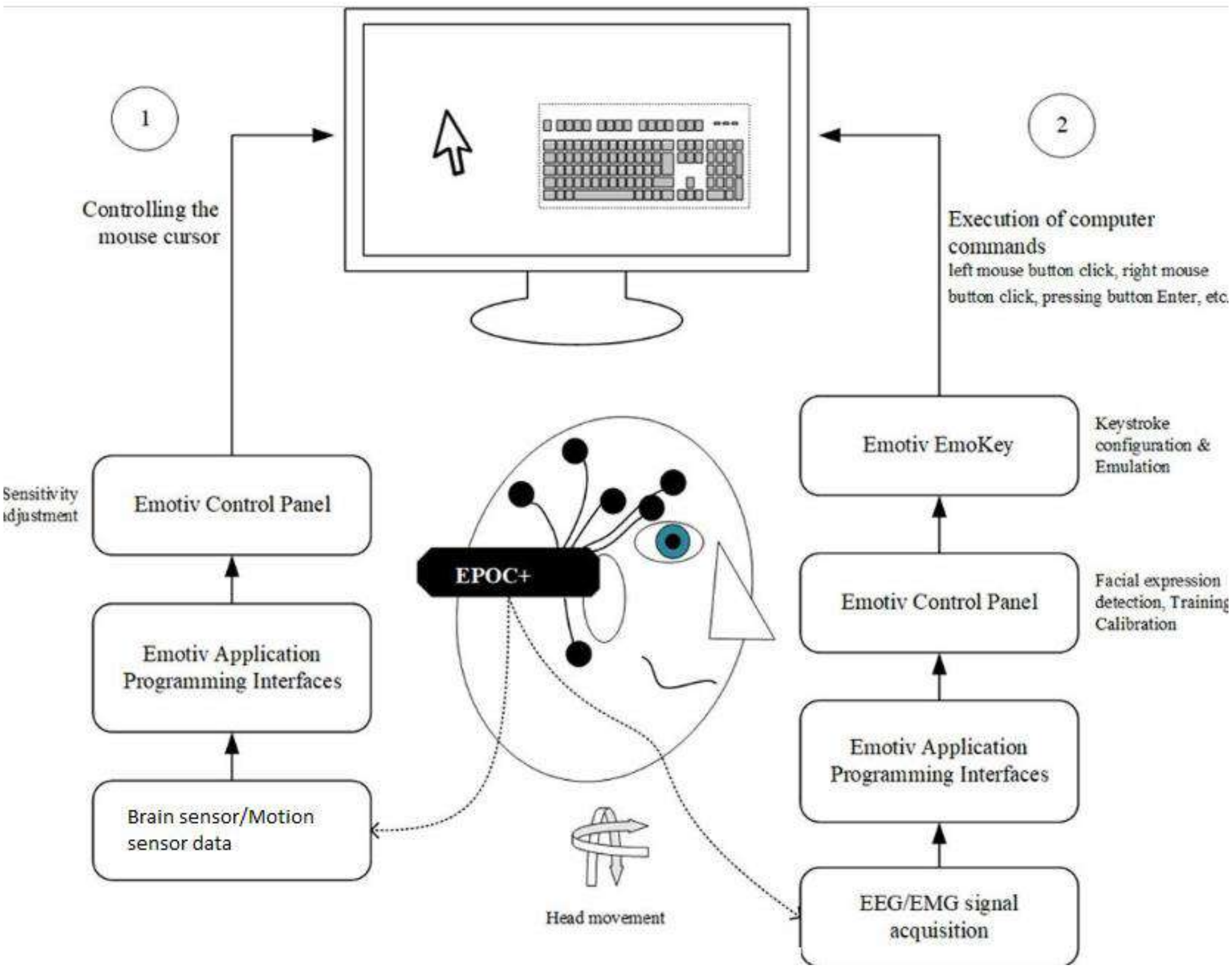
Double-Blinking Detection:
The system will detect double-blinking events using EMD-processed EEG signals. Features, such as the energy of intrinsic mode functions (IMFs) and residuals, will be extracted and used for classification.

Cursor Control:
Gyroscope data will be used for cursor movement control. Kalman filtering will be employed to estimate the cursor's position, providing precise control and jitter removal.

Performance Evaluation:

The system's performance will be evaluated through tests involving users with diverse abilities. Detection rates, cursor control accuracy, and user feedback will be assessed.

Block Diagram:



TIME LINE:

Work Schedule perweeks	Sep-Oct	Nov-Dec	Jan-Feb	Mar-Apr	May	June
Literature Survey	18-09-2023 4-10-2023					
Data Collection	05-10-2023 01-11-2023	02-11-2023 03-12-2023	05-01-2024 31-01-2024			
Hardware/Softwar eImplementation		02-12-2023 29-12-2023	02-02-2024 27-02-2024	01-03-2024 29-04-2024		
Result Compilation & Thesis Writing					02-05-2024 29-05-2024	01-06-2024 15-06-2024

References:

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