All Sciences Proceedings
http://as-proceeding.com/

AS-ABSTRACTS
https://as-proceeding.com/index.php/as-abstracts
ISSN: 2980-1834

All Sciences Abstracts,
Volume 1, pp 8, 5, 2023

Real-Time Obstacle Detection in 3D Environments Using P300-based EEG Signals

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Abstract – The research introduces a new system for obstacle detection in 3D spaces using P300 event-related potential from EEG signals. By incorporating brain-computer interfaces with robotics, this method enhances intuitive human-robot interaction. The system utilizes the Common Spatial Pattern (CSP) algorithm to identify distinct EEG features, improving the safety and adaptability of robots. Tested in a custom 3D simulation environment, the system demonstrated high accuracy and real-time performance, indicating its potential for applications like autonomous navigation and assistive robotics. This study represents a significant step in robotics and brain-computer interfaces, fostering a more natural user interface and propelling advancements in the field.

Keywords – Obstacle Detection, P300, EEG Signals, Brain-Computer Interface, Robotics, Common Spatial Pattern, Real-Time, Human-Robot Interaction.