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Center for Assistive, Rehabilitation & Robotics Technologies
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BCI-Controlled Hands-Free Wheelchair Navigation with Obstacle Avoidance

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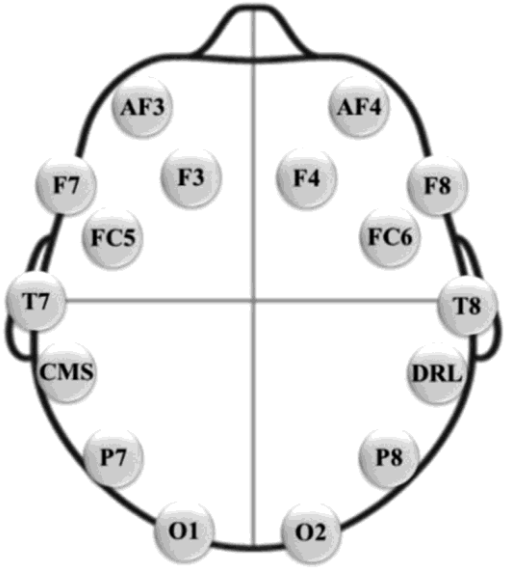
Introduction

Brain Computer Interfaces (BCI) are widely used in reading brain signals and converting them into real world motion.

Objectives:

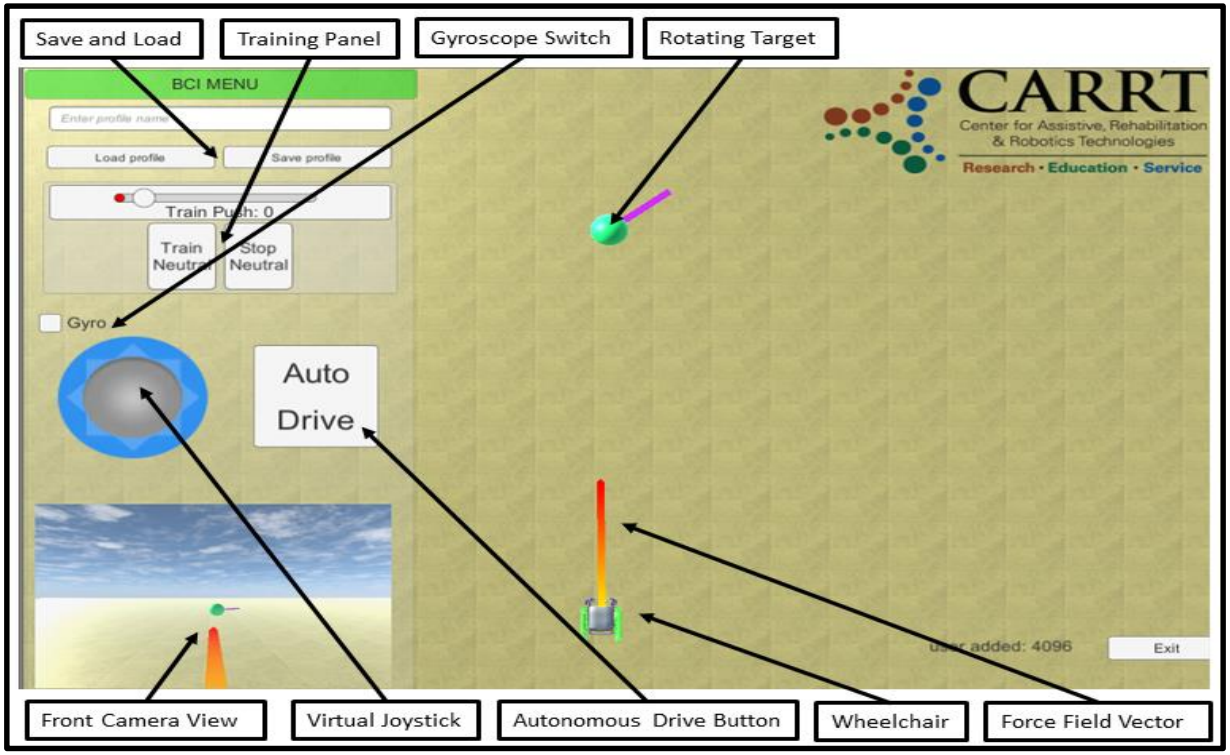
- Create a relatively easy-to-use, BCI controlled Wheelchair.
- Use ultrasonic sensor rings to assist BCI navigation, avoid obstacles and increase safety.
- Navigate using only brain commands and ultrasonic sensors.
- Minimize training time by using one mental command.



User Interface

The GUI offers:

- Real-time position & orientation of wheelchair (from encoders) and obstacles (from sensors).
- Training Panel for BCI command training.
- Virtual Joystick, Autonomous drive button and Gyroscope Switch.



Obstacle Avoidance

- Potential Field algorithm utilized using Eight sensors (4 on each side) detect obstacles.
- Obstacles generate a repulsive force, while target generates an attraction force.
- The net force navigates the wheelchair autonomously through a PID controller.

Brain-Computer Interface

Human Subject Testing:

- 6 subjects were trained for 10 minutes and asked to move the target to a predefined position.
- Subjects successfully moved the target to the destination in an average of 287 seconds.
- One mental command is used to move the target in 2D space.