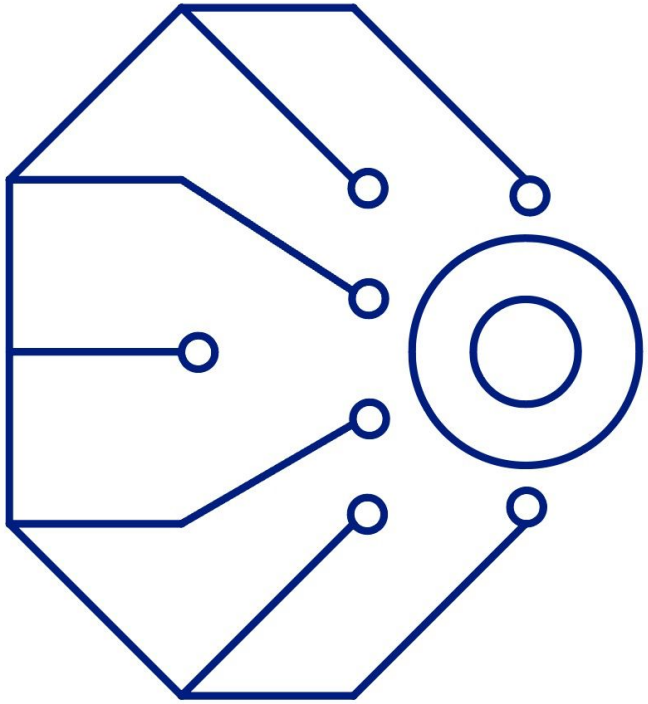

NeuroToys

Non-Invasive Brain Computer Interface for Real-Time Robot Control

Team 9
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Problem Statement

How can we enable users to control technology effortlessly and intuitively using only their thoughts?

The challenge:

Current external device control methods (ex: joysticks, remotes) can be restrictive for individuals with mobility impairments or those seeking new ways of interaction.

Our Solution:

A non-invasive brain-computer interface (BCI) that translates brainwave patterns into real-time commands for controlling a robotic toy.

Problem Statement

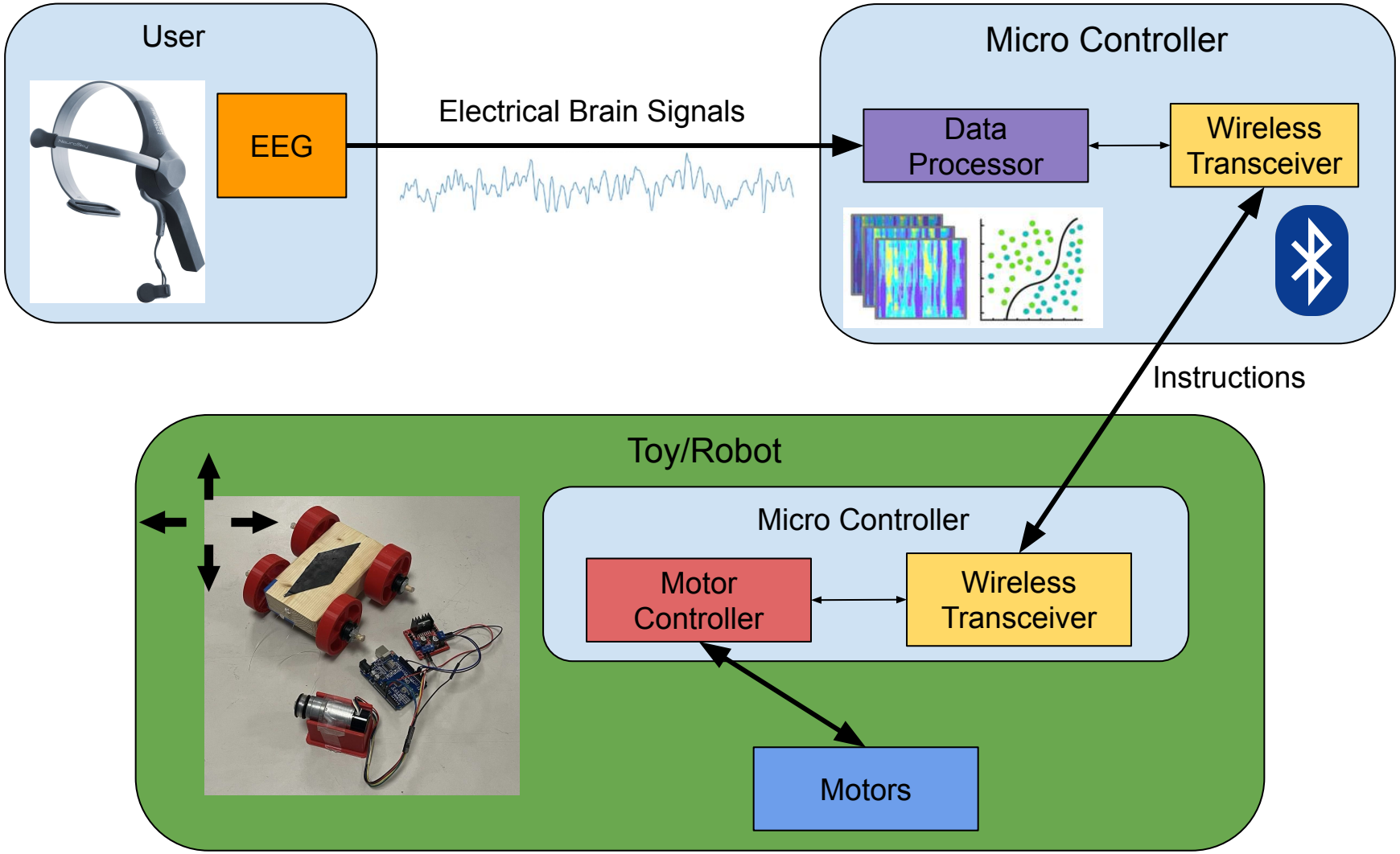
How can we enable users to control technology effortlessly and intuitively using only their thoughts?

Why it Matters:

Enhances accessibility, providing users with limited mobility the ability to control technology in an intuitive and innovative way.

Offers a new approach to human-machine interaction, allowing for more immersive experiences.

Visualization



Deliverables

Functional Robotic Toy Controlled by Brain Signals

A fully operational robotic toy that executes real-time movements based on electrical pattern of neural commands.

EEG Data Processing and Classification Software/Pipeline

An advanced signal processing software system that denoises, filters, and classifies EEG brain data.

Mechanical Design and CAD Prototypes

Complete CAD designs and 3D-printed components for the robotic toy, integrating motorized structures and control systems.

Requirements (functions)

Acquire EEG Signals in Real Time

Device should capture signals with a sampling rate of at least 250 Hz and maintain 90% signal clarity after filtering

Classify Brain Patterns with Machine Learning

Classification accuracy should be above 80% for a given set of mental commands

Control Robotic Movements

Robotic response delay should be under 500 milliseconds

Provide Real-Time Feedback

Feedback must be provided within 300 milliseconds of command execution

Requirements (objectives)

Seamless User Experience

System setup should take no longer than 25 mins, calibration should not exceed 5 mins

Accurate Command Recognition

Command recognition accuracy must exceed 85% after initial calibration

Portable and Wireless

Communication range between the EEG cap and the toy must be at least 10 meters

Robust Signal Processing

Signal processing should achieve at least 95% noise reduction from artifacts such as muscle signals or environmental noise

Requirements (constraints)

Non-Invasive Technology

Only an external EEG cap can be used to capture brain activity

Power Consumption

EEG cap and toy must operate for a minimum of 2 hours on rechargeable battery

Latency

Total system latency should not exceed 500 milliseconds

Cost

The cost of all components must be tracked, final budget should not surpass $750

Safety Standards

System should comply with relevant IEEE and FCC standards for safe operation

Competing Technologies / Patents / Other Products

Emotiv EPOC EEG Headset Series

Commercial-grade EEG headsets offering real-time brain signal acquisition and classification. NeuroToys aims to replicate the user-friendly experience, but at a much lower price point, enhancing accessibility for users.

EEG-Controlled Assistive Robots

Existing robotic systems use EEG to aid paralyzed individuals in rehabilitation, achieving 80.83% real-time accuracy. NeuroToys will reduce EEG electrode complexity and set-up time, maintaining performance while improving usability and cost-efficiency.