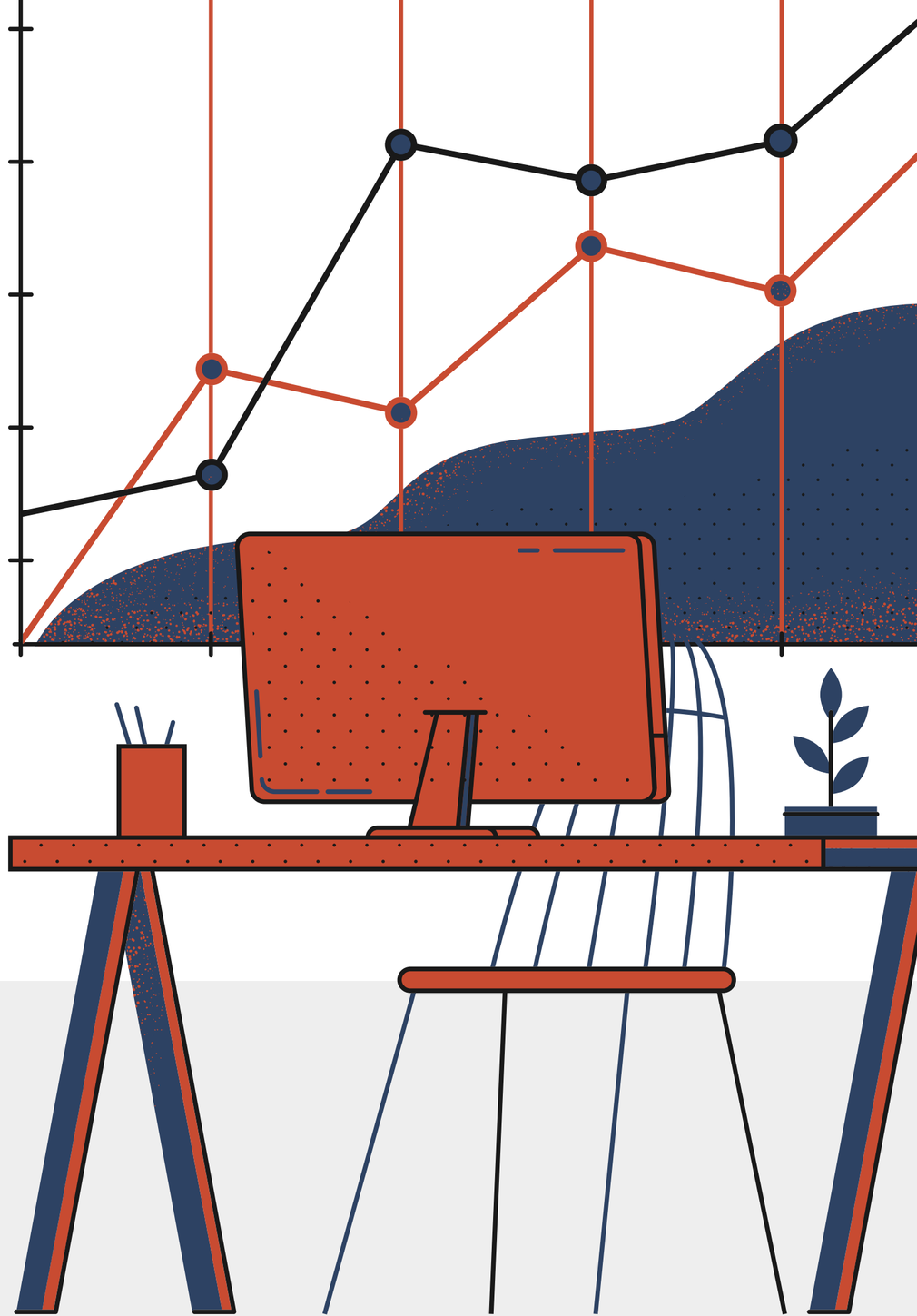
INTERNATIONAL BRAIN IBRO RESEARCH ORGANIZATION

ARABS IN NEUROSCIENCE

The American University in Cairo
School of Sciences and Engineering

Canonical Correlation Analysis for SSVEP Detection



STUDENTS

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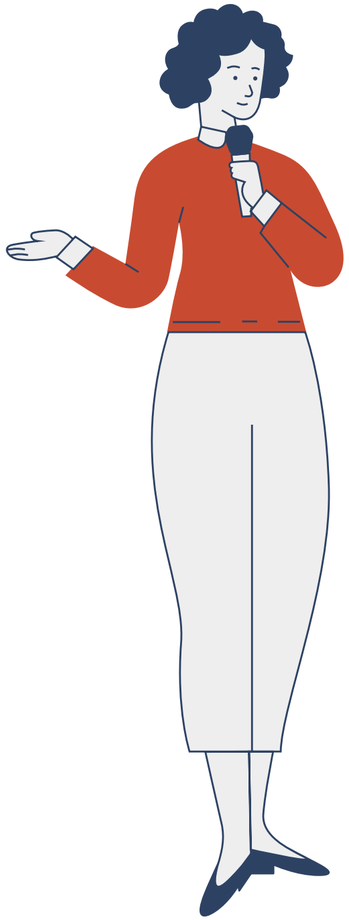
- **Objective:**

  To apply Canonical Correlation Analysis (CCA) for classifying EEG data in real-time using an SSVEP-based system.

- **Key Features of the Application:**
  - Real-time classification of EEG data from multiple subjects.
  - Uses CCA for frequency detection.
  - Supports future improvements with advanced techniques.

Overview of SSVEPs:

Steady-State Visual Evoked Potentials (SSVEPs) are continuous brain responses generated when an individual visually focuses on a stimulus flickering at a specific frequency.



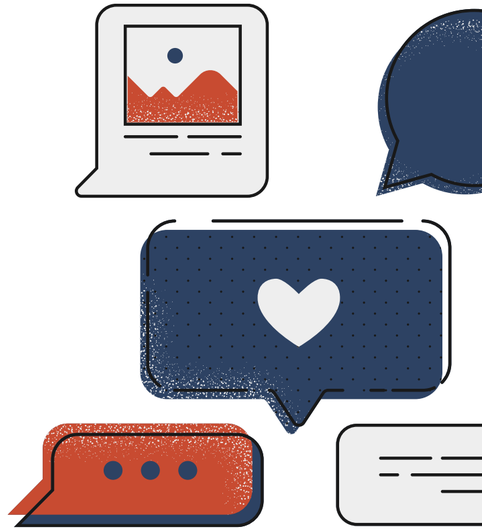
Application Flow:

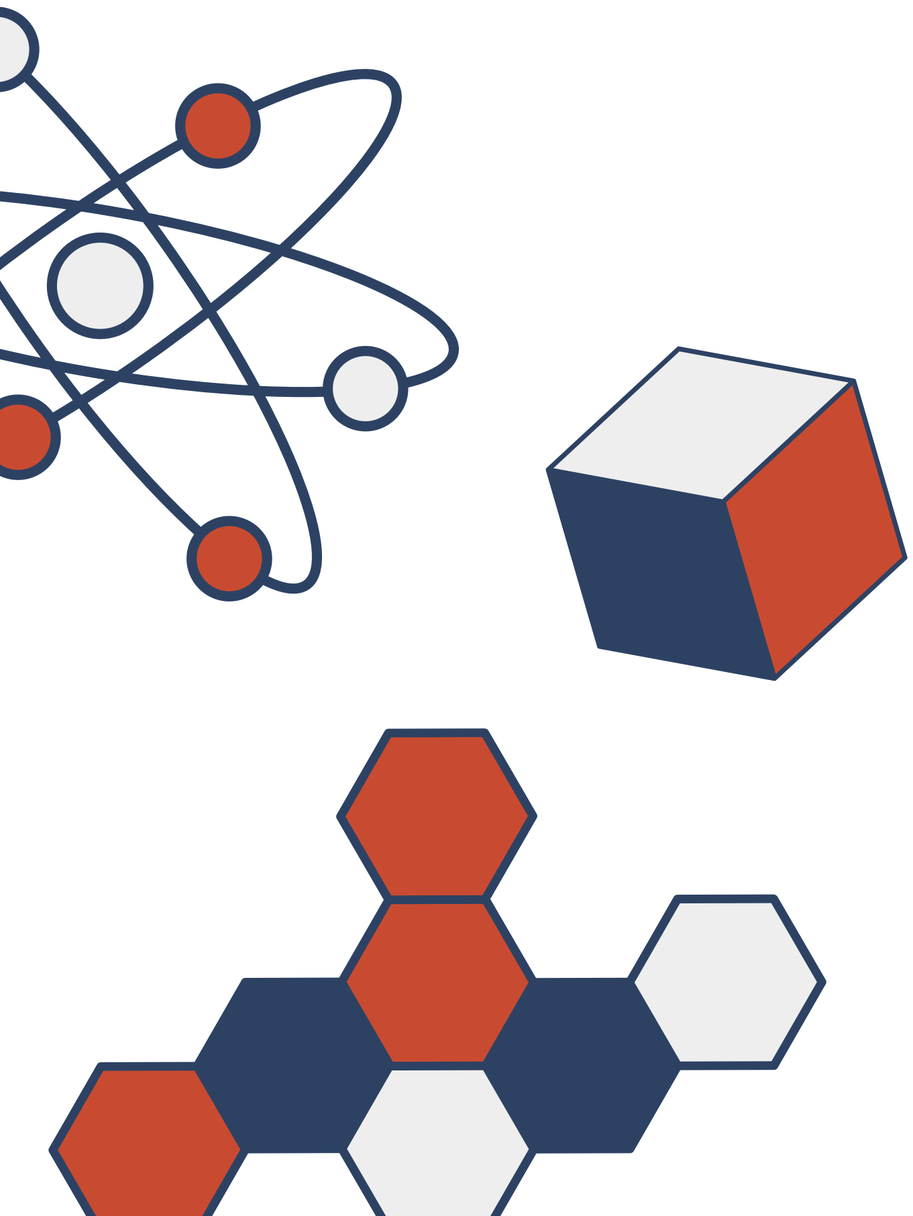
1. **Data Acquisition**: Live EEG data input.

2. **Preprocessing**: Filtering and epoch extraction as described.

3. **CCA-based Detection**: Correlates processed EEG data with reference signals.

4. **Real-time Classification**: Outputs frequency class in real-time for the targeted stimulus.





Preprocessing Steps:

1. Filtering:

- Band-pass filter applied to the EEG data (6Hz to 80Hz) to remove noise and non-relevant frequencies.

2. Artifact Removal:

- Eye movement and blink artifacts reduced by instructing subjects to avoid blinking during stimulus presentation.

3. Epoch Extraction:

- Time windows extracted from the EEG data around the stimulus onset with a 135ms latency correction for visual processing delays.

Canonical Correlation Analysis (CCA)

Standard CCA:

- Correlates multi-channel EEG with predefined sinusoidal reference signals.
- Used to identify target stimulus frequencies.

Benefits:

- No calibration needed, robust in detecting SSVEPs.

Why CCA:

CCA provides efficient correlation of EEG signals with sinusoidal references, making it a powerful tool for SSVEP frequency detection in brain-computer interface (BCI) applications.

Key APP Features:

- Real-time EEG data analysis.
- CCA used for frequency identification between 9.25Hz and 14.75Hz.
- High processing efficiency, suitable for multi-user environments.

Results & Accuracy

Accuracy per Subject:

- Subject 4: 76.38% Accuracy
- Subject 6: 79.44% Accuracy
- Subject 7: 64.86% Accuracy
- Subject 9: 61.38% Accuracy
- Average accuracy across subjects: ~60%

Future Improvements:

- **Use of IT-CCA:**

  We plan to incorporate the IT-CCA technique, which uses individualized templates for better characterization of SSVEP signals, further improving classification accuracy.

- **Additional Channels and Harmonics:**

  Exploring increased electrode coverage and more harmonics to refine detection capabilities.

Summary:

The APP effectively applies CCA for real-time SSVEP detection, and future improvements with IT-CCA will further enhance accuracy and efficiency.

The End

Thank you for listening