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Brain Machine Interface Using Electroencephalograph Data as Control Signals for a Robotic Arm

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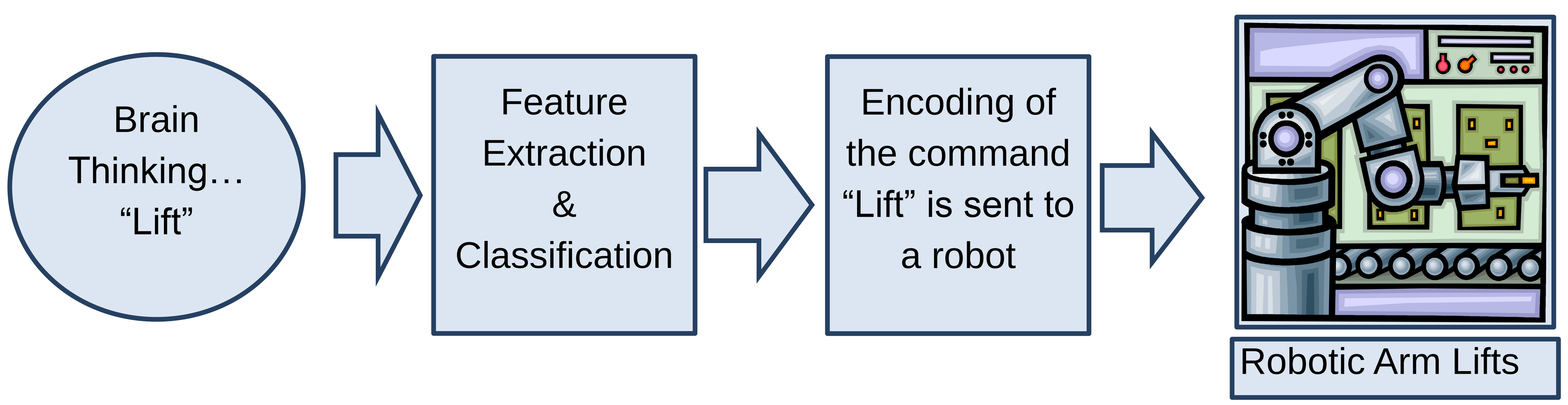
Introduction

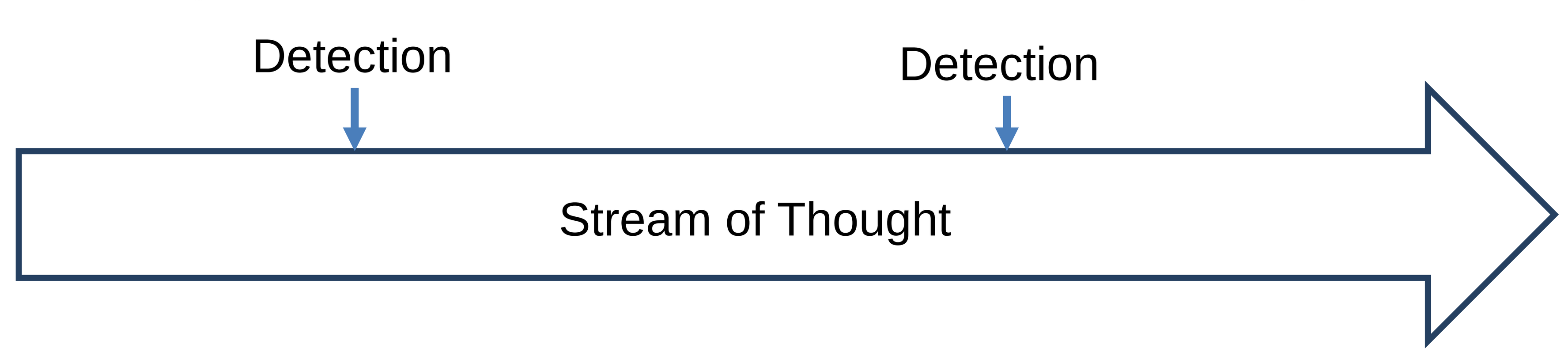
Brain machine interfaces (BMI) – also known as brain computer interfaces (BCI) – use sensors such as electroencephalographs (EEG). These systems use a number of electrodes to read electrical signals on the scalp caused by brain activity. The patterns generated by certain thoughts can be classified and used as control signals for a BMI system. The completed system allows a user to control a computer, robot, or other device by using thought as the only input mechanism.

System Overview



System Characteristics

Asynchronous: detections can occur at any time.



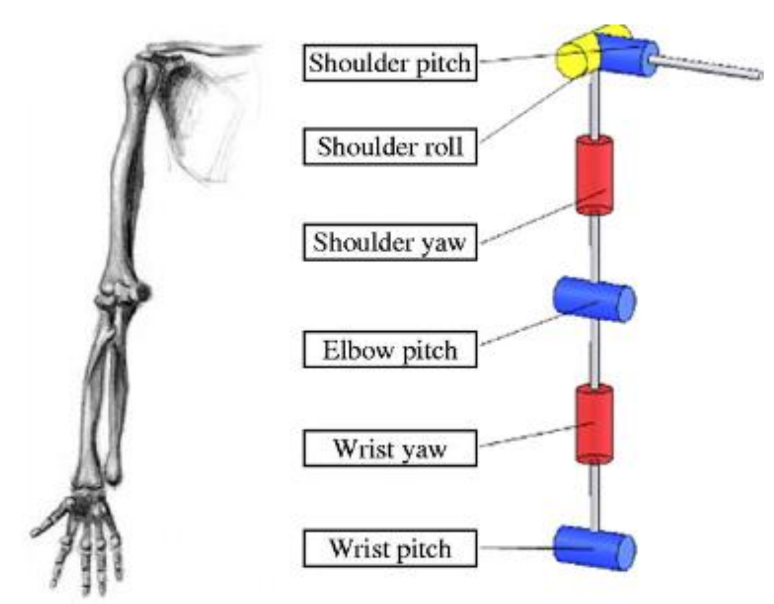
Non-Invasive: EEG systems use electrodes placed on the scalp for data collection instead of electrodes placed inside the skull or directly on the brain.

Closed Loop: This closed loop system provides feedback to the user through visual queues. The robotic arm will respond with motion to specific commands.

The EEG Headset

14-electrode wireless EEG headset called the EPOC headset produced by EMOTIV.

The Robotic Arm



Degrees of Freedom Comparison Between Cyton Veta Robotic Arm and Human Arm

Human Arm		*Robotic Arm*	
Shoulder Roll	240°	Shoulder Roll	230°
Shoulder Pitch	180°	Shoulder Pitch	300°
Shoulder Yaw	90°	Elbow Roll	240°
Elbow Pitch	140°	Elbow Pitch	300°
Wrist Roll	170°	Wrist Roll	210°
Wrist Pitch	70°	Wrist Pitch	220°
Wrist Yaw	90°	Wrist Yaw	300°

Action Encoding and Current Results

Lower **Grab** **Lift** **Rotate** **Lower** **Release**

Currently the system maps specific thought patterns through the algorithms provided in the Emotiv SDK shipped with the EPOC headset. Positive classifications are mapped to 6 actions (lower, grab, lift, rotate left, rotate right, and release). Users have been able to execute from one to six of these controls with varying degrees of reliability.

Future Work

Focus will be on developing and improving classification algorithms in order to shift the burden of learning onto the computer rather than the user. Additionally, the set of recognized actions will be modified or expanded to allow much more flexible control.