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

Kelly Cashion  
*University of Dayton, stander@udayton.edu*

Carly A. Gross  
*University of Dayton, stander@udayton.edu*

Follow this and additional works at: [http://ecommons.udayton.edu/stander_posters](http://ecommons.udayton.edu/stander_posters)

Recommended Citation

[http://ecommons.udayton.edu/stander_posters/232](http://ecommons.udayton.edu/stander_posters/232)
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**

**Brain Thinking… “Lift”**

**Feature Extraction & Classification**

**Encoding of the command “Lift” is sent to a robot**

**Robotic Arm Lifts**

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

**Kelly Cashion, Carly Gross, Theus Aspiras**

Advisor: Dr. Vijayan Asari

Department of Electrical and Computer Engineering

**Introduction**

Asynchronous: detections can occur at any time.

Detection

Detection

Stream of Thought

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**

<table>
<thead>
<tr>
<th>Human Arm</th>
<th>Robotic Arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder Roll</td>
<td>240⁰</td>
</tr>
<tr>
<td>Shoulder Pitch</td>
<td>180⁰</td>
</tr>
<tr>
<td>Shoulder Yaw</td>
<td>90⁰</td>
</tr>
<tr>
<td>Elbow Pitch</td>
<td>140⁰</td>
</tr>
<tr>
<td>Wrist Roll</td>
<td>170⁰</td>
</tr>
<tr>
<td>Wrist Yaw</td>
<td>90⁰</td>
</tr>
</tbody>
</table>

**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.