4-17-2013

EEG Action Encoding

EEG Action Encoding

Carly A Gross, Kelly Cashion, Theus H Aspiras
Dr. Vijayan K Asari

Emotion Recognition

Develop methods to incite emotional responses in detecting unique brainwave signatures through electroencephalograph (EEG) recordings

Optimize various noise-reduction, feature extraction, and classification algorithms

Create a real-time brain-computer interface compiling all methods and algorithms for emotion detection and recognition

Data Acquisition

EPOC neuroheadset by Emotiv

- TestBench software
- Complete software for gathering, displaying, and analyzing electroencephalograph (EEG) data.
- The Expressiv Suite is used to detect a user's facial expression
- The Affectiv Suite can be used to detect a user's emotional state
- The Cognitiv Suite can be used to read and interpret a user's thoughts
- 16-channel EPOC neuroheadset
- Windows 7 64-bit data acquisition computer

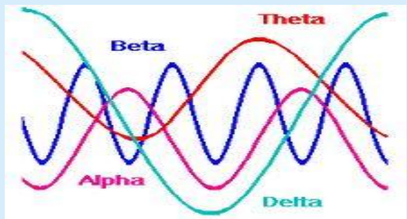
Various Actions to Map

Lift/Lower
Move (Left/Right)
Rotate (Clockwise/Counterclockwise)
Grab/Release

Procedure

The procedure is as follows:

1. Identify a set of simple actions that can be applied to the manipulation of a robotic arm.
2. Obtain EEG data corresponding to test subject's thinking of performing each of the simple actions defined in the set.
3. Analyze the variations in source locations in each case with respect to the normal case.
4. Establish a metric of source locations and variations in locations for each of the simple actions in the set.
5. Obtain the source locations and variations with the new set of EEG test data.
6. Classify the action that created the new set of EEG data into an action based on the source locations and variations in locations.

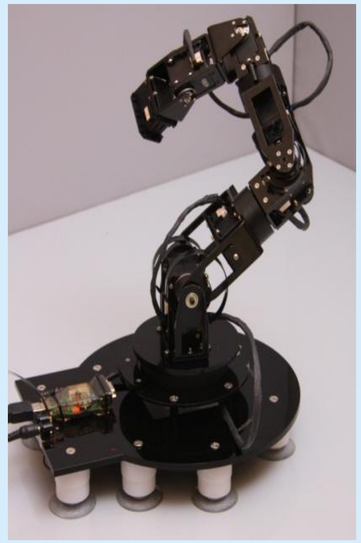


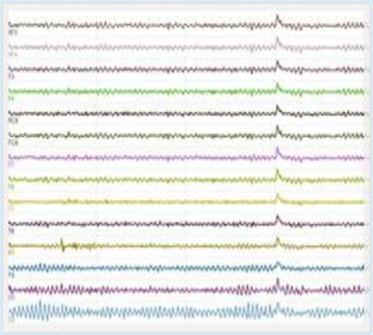
Procedure to Convert Data to an Action

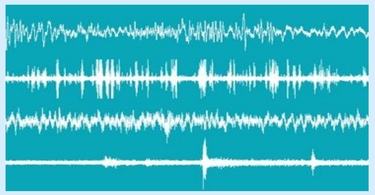
1. Collect the 256-channel EEG data in response to various commands.
2. Classify the data into a command and magnitude for that command.
   a. Match the EEG data to one of the commands in the action set.
   b. Match the magnitude of the command to one of a set of possible magnitudes.
3. Convert the EEG data into a command that can be processed by the robotic arm, generating an appropriate response.
   a. Compare the EEG data to a set of pre-defined commands for the robotic arm.
   b. After matching the data, send the appropriate command to the robotic arm.
   c. Define boundaries, such as start time, stop time, and speed of the motion according to the magnitude of the action acquired from the EEG data.
   d. Send corresponding signals to the robotic arm to control the action using the boundaries acquired from the EEG data.

Applications and Future Research

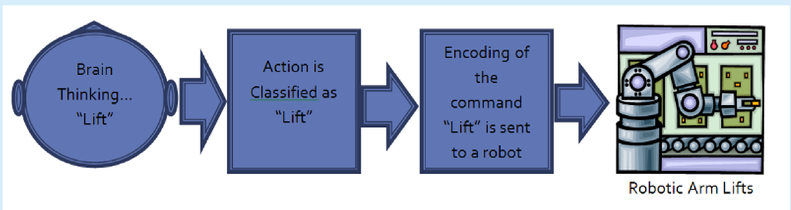
- Assist handicapped workers
- Communicate with coma patients
- Respond to a user's feelings
- Complete dangerous tasks
- Track a user's emotional state
- Use thoughts to run applications







General Flow of Data



Data Acquisition Procedure

Setting up the system requires several minutes of preparation, including setup on the participant.
System startup
Experimental acquisition setup
Participant setup
- Soaking Sensor Sponges in contact solution
- Application of the headset on participant
- Proper contact of electrodes to system

Final System Check
This is to ensure correct and valid results for our data acquisition. We will commence preliminary checks in the place of acquisition to make sure electrical noise will be at a minimum. We will also need a preliminary check of system data acquisition to correct noise from movement of the subject and/or the environment during the experiment.