



EEG Control (II)

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November 25th 2011*



Glossary

- ▶ Affectiv Suite: emotional state.
- ▶ Cognitiv Suite: conscious thoughts.
- ▶ Expresiv Suite: facial expressions.

- ▶ Emotiv SDKLite™: A version of the Emotiv SDK that uses neuroheadset emulation to allow integration with new and existing software. Software developed will be compatible with the Emotiv EPOC™ headset.



Glossary

- ▶ EmoComposer™: An Emotiv EmoEngine™ emulator for development.
- ▶ EmoKey™: Tool to translate EmoStates™ into signals that emulate traditional input devices (such as keyboard).
- ▶ EML : EmoComposer™ Markup Language – an XML-based syntax that can be interpreted by EmoComposer to playback predefined EmoState values.
- ▶ EmoScript™: A text file containing EML, which can be interpreted by EmoComposer to automate the generation of predefined EmoStates.

Parts of the API: Emotiv Control Panel™



Emotiv Control Panel 1.0.0.0-LITE

Application Connect Help

ENGINE STATUS

System Status: Emotiv Engine is ready

System Up Time: 0

Wireless Signal ○ ○ ○ ○

Battery Power: No Battery Meter Detected

USER STATUS

Headset: [Dropdown]

User: [Dropdown]

Add User... Remove User Save User

Headset Setup Expressiv Suite Affectiv Suite Cognitiv Suite

Status: No signal...

Headset Diagram (14 dots)

The first time, your firewall software (if installed on your computer) may notify you that the Control Panel is trying to accept connections from the network (port 3008). You must allow Emotiv Control Panel to use this port by selecting Unblock (or a similar option, depending on your firewall software).

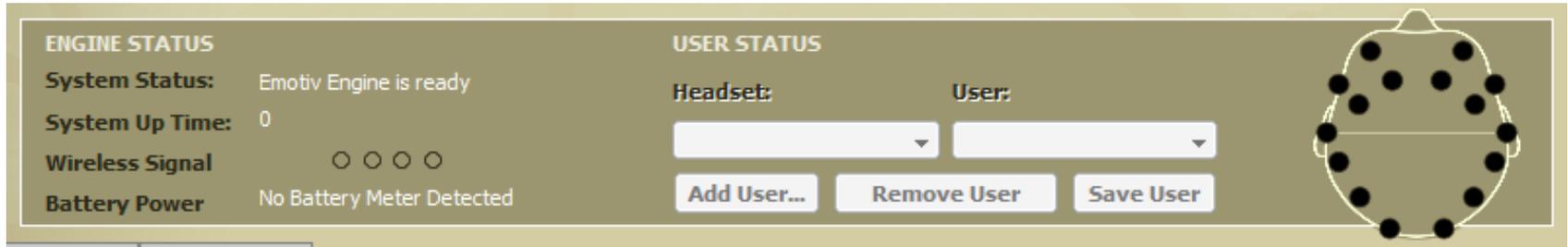


Parts of the API: Emotiv Control Panel™

- ▶ Provides a GUI (graphical user interface) that interfaces with Emotiv EmoEngine through the Emotiv API.
- ▶ Interface showcases the EmoEngine's capabilities to decipher brain signals and present them in useful forms using Emotiv's detection suites.



Parts of the API: Emotiv Control Panel™

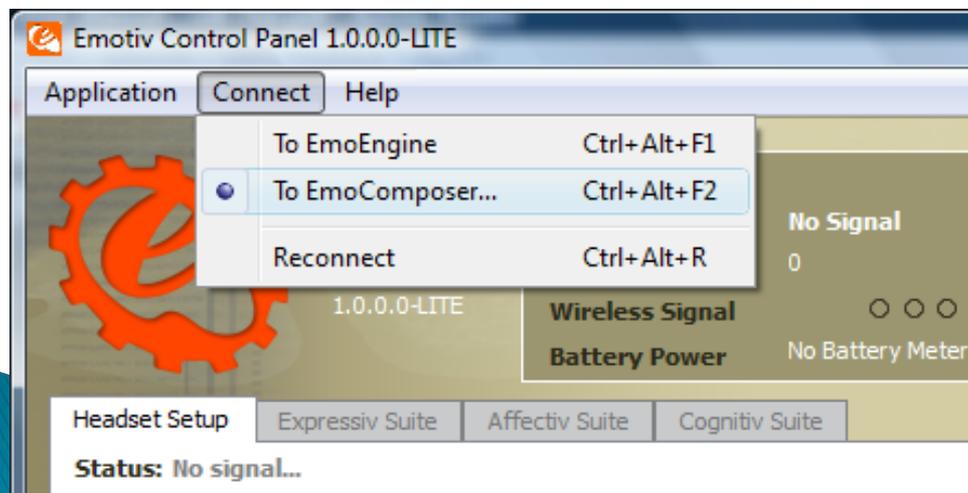


- ▶ This is the EmoEngine Status Pane.
- ▶ Displays indicators that provide real-time information status and neuroheadset sensor contact quality.
- ▶ It also exposes user profile management controls.



Parts of the API: Emotiv Control Panel™

- ▶ May connect to EmoComposer, (emulator tool) from the *Connect* menu.
- ▶ **SDKLite Developers**: you will need to change this menu setting and connect to EmoComposer.
- ▶ EmoComposer should be launched prior to selecting this option in Control Panel.



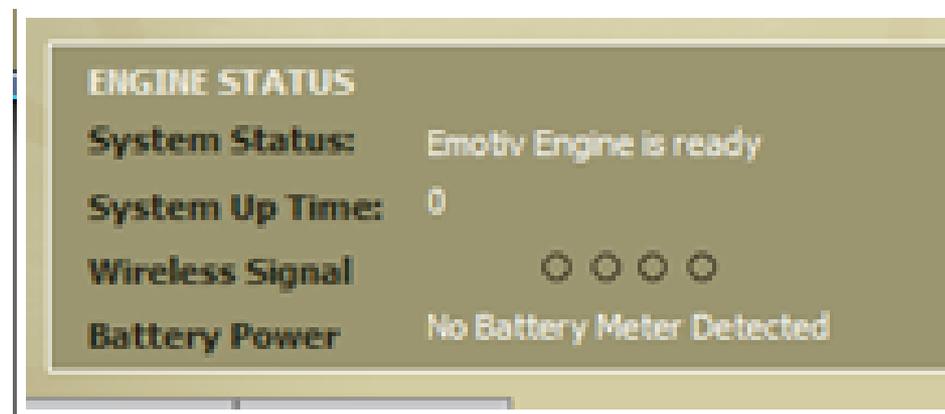
Host: 127.0.0.1

Port: 3008



Parts of the API: Emotiv Control Panel™

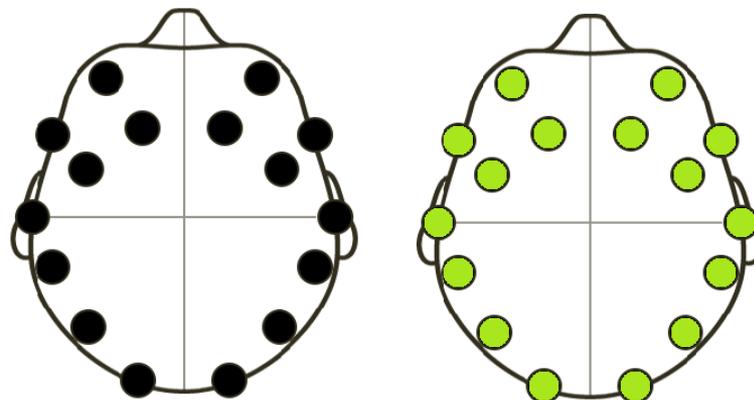
- ▶ *System Status*: A summary of the general EmoEngine status.
- ▶ *System Up Time*: The timestamp (in seconds) attached to the most recently received.
- ▶ *Wireless Signal*: This displays the quality of the connection between the neuroheadset and the Emotiv wireless USB receiver connected to your machine.
- ▶ *Battery Power*: Displays an approximation of the remaining charge in the neuroheadset's built-in battery.



Parts of the API: Emotiv Control Panel™

- ▶ Although the EmoEngine supports up to two real simultaneously connected neuroheadsets, Emotiv Control Panel only displays status information and detection results for a single neuroheadset at a time.
- ▶ Accurate detection results depend on good sensor contact and EEG signal quality. This display is a visual representation of the current contact quality of the individual neuroheadset sensors

Black	No signal
Red	Very poor signal
Orange	Poor signal
Yellow	Fair signal
Green	Good signal



Parts of the API: Expressiv™ Suite



- ▶ One example: Look right and smile.

Put the “Lower face”,
action = Smile,
value = 1
(values from 0 to 1)

1

2

3

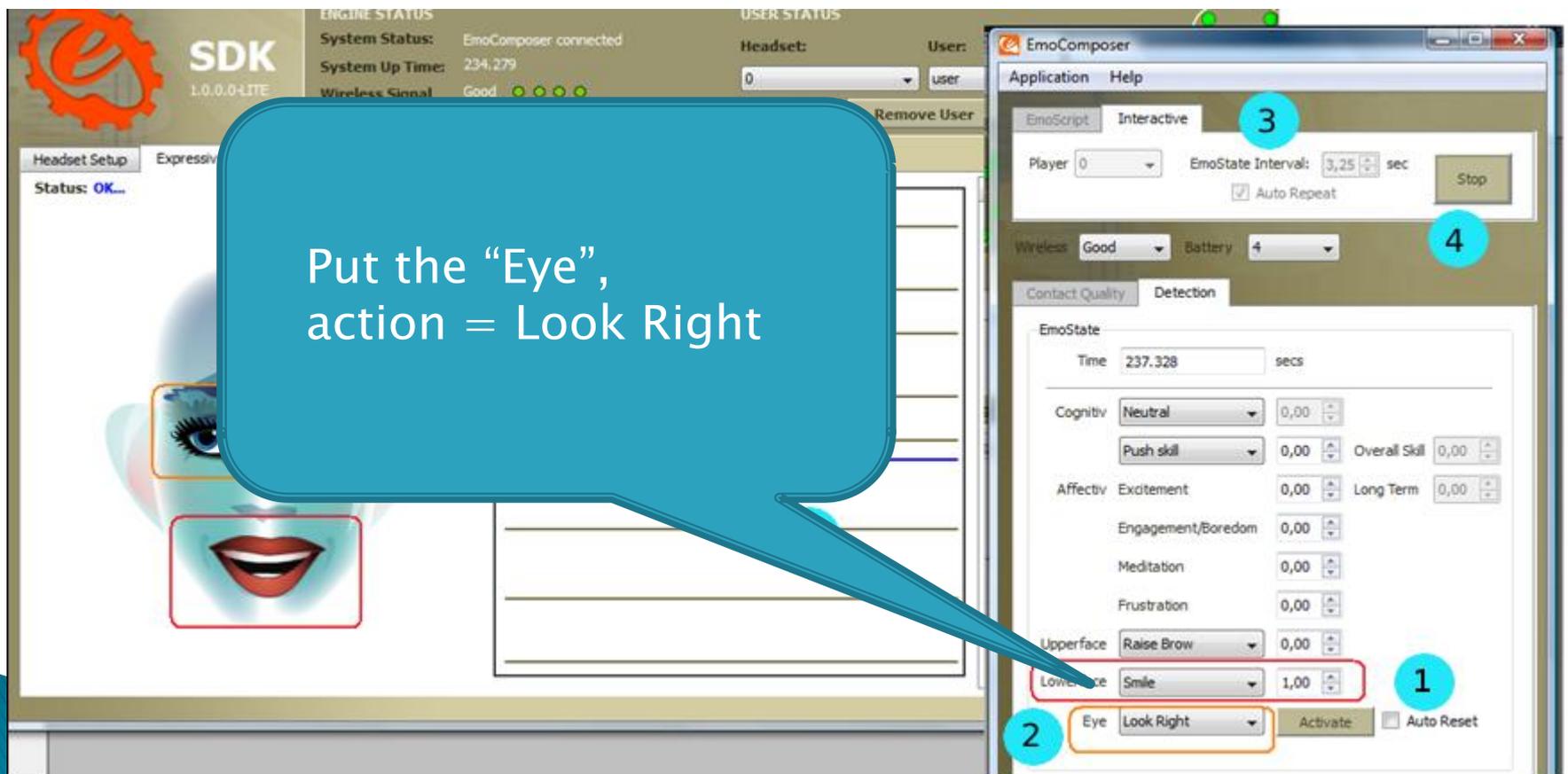
4

6

The image shows a screenshot of the Expressiv SDK interface. On the left, there's a 3D model of a face with a red box around the mouth area, labeled '6'. In the center, a blue callout box contains the text: 'Put the “Lower face”, action = Smile, value = 1 (values from 0 to 1)'. On the right, the EmoComposer application window is open, showing various controls. A red box highlights the 'Lowerface' dropdown set to 'Smile' with a value of '1,00', labeled '1'. An orange box highlights the 'Eye' dropdown set to 'Look Right', labeled '2'. A blue circle highlights the 'Interactive' tab, labeled '3'. Another blue circle highlights the 'Auto Repeat' checkbox, labeled '4'. The background shows the SDK interface with 'ENGINE STATUS' and 'USER STATUS' sections.

Parts of the API: Expressiv™ Suite

- ▶ One example: Look right and smile.

The image shows a screenshot of the Expressiv SDK and EmoComposer software. On the left, the SDK interface displays system status (EmoComposer connected, System Up Time: 234,279, Wireless Signal: Good) and a 3D avatar of a woman's face. The avatar's eyes are highlighted with a blue box (2) and her mouth with a red box (1). A blue speech bubble points to the eyes with the text "Put the 'Eye', action = Look Right". On the right, the EmoComposer window shows the "Interactive" tab (3) with a "Player" dropdown set to 0 and an "EmoState Interval" of 3,25 sec. The "Auto Repeat" checkbox is checked. Below this, the "Detection" tab shows various EmoState parameters. The "Eye" dropdown is set to "Look Right" (2) and the "Lower Face" dropdown is set to "Smile" (1). The "Upperface" dropdown is set to "Raise Brow". The "Time" field shows 237.328 secs. The "Overall Skill" and "Long Term" fields are both set to 0,00. The "Eye" dropdown is highlighted with a blue box (2) and the "Smile" dropdown with a red box (1).

Put the "Eye",
action = Look Right

Parts of the API: Expressiv™ Suite



- ▶ One example: Look right and smile.

Define the “EmoState Interval”

Confirm “Auto Repeat” box (for long time)

1 Lowerface Smile 1,00

2 Eye Look Right

3 EmoComposer Interactive 3,25 sec

4 Auto Repeat

6

SDK 1.0.0.0-LITE

ENGINE STATUS
System Status: EmoComposer connected
System Up Time: 234,279
Wireless Signal: Good

USER STATUS
Headset: 0
User: user
Remove User

Headset Setup Expressiv
Status: OK...

EmoComposer
Application Help

EmoScript Interactive

Player 0 EmoState Interval: 3,25 sec Stop

Auto Repeat

Wireless Good Battery 4

Contact Quality Detection

EmoState
Time 237.328 secs

Cognitiv Neutral 0,00
Push skill 0,00 Overall Skill 0,00

Affectiv Excitement 0,00 Long Term 0,00

Engagement/Boredom 0,00

Meditation 0,00

Frustration 0,00

Upperface Raise Brow 0,00

Lowerface Smile 1,00

Eye Look Right Activate Auto Reset

Parts of the API: Expressiv™ Suite



- ▶ One example: Look right and smile.

The screenshot displays the Expressiv™ Suite software interface. On the left, there is a 3D model of a human face with red and blue boxes highlighting the mouth and eye areas, respectively. A blue callout box with a white border points to the 'Start' button in the 'EmoComposer' window. The 'EmoComposer' window has several tabs: 'EmoScript', 'Interactive', 'Contact Quality', and 'Detection'. The 'Interactive' tab is active, showing a 'Player' dropdown set to '0', an 'EmoState Interval' of '3,25' seconds, and a 'Stop' button. The 'Detection' tab is also visible, showing various 'EmoState' parameters such as 'Cognitiv', 'Affectiv', 'Engagement/Boredom', 'Meditation', 'Frustration', 'Upperface', 'Lowerface', and 'Eye'. The 'Lowerface' dropdown is set to 'Smile' and the 'Eye' dropdown is set to 'Look Right'. A 'Start' button is located at the bottom of the 'EmoComposer' window. The background shows the 'SDK' (1.0.0.0-LITE) interface with 'ENGINE STATUS' and 'USER STATUS' sections.

If all is all right, click at the button “Start” (change to Stop)

1 Lowerface Smile 1,00

2 Eye Look Right

3 Interactive

4 Stop

6

Parts of the API: Expressiv™ Suite



- ▶ One example: Look right and smile.

The screenshot displays the Expressiv SDK interface. On the left, a cartoon face is shown with a red box around the eyes and a blue box around the mouth. To the right, a graph shows a signal trace with a red circle around a peak labeled '5'. The top right corner shows 'ENGINE STATUS' and 'USER STATUS' sections. The 'ENGINE STATUS' section includes: System Status: EmoComposer connected, System Up Time: 234,279, Wireless Signal: Good (indicated by four green dots), and Battery Power: High (indicated by four green dots). The 'USER STATUS' section includes: Headset: 0, User: user, and buttons for 'Add User...' and 'Remove User'. The 'EmoComposer' window is open, showing 'EmoScript' and 'Interactive' tabs. The 'Interactive' tab has a '3' in a blue circle. It includes a 'Player' dropdown set to '0', an 'EmoState Interval' of '3,25' sec, an 'Auto Repeat' checkbox, and a 'Stop' button. Below this, 'Wireless' is set to 'Good' and 'Battery' is set to '4', with a '4' in a blue circle. The 'Contact Quality' and 'Detection' sections show 'EmoState' with a 'Time' of '237.328' secs and 'Cognitiv' set to 'Neutral'.

Can see the eyes movement at the cartoon and signal changing

Parts of the API: Expressiv™ Suite



- ▶ One example: Look right and smile.

The screenshot displays the Expressiv SDK interface. On the left, a 3D model of a female face is shown with a blue bounding box around the eyes and a red bounding box around the mouth. In the center, a graph shows a signal line that steps up and then levels off, with a red circle around the step and a blue circle containing the number '6'. On the right, a control panel includes a 'Push skill' dropdown set to '0,00', an 'Overall Skill' slider at '0,00', and an 'Affectiv Excitement' slider at '0,00'. Below these are sliders for 'Engagement/Boredom', 'Meditation', and 'Frustration', all at '0,00'. The 'Upperface' section has a 'Raise Brow' dropdown at '0,00'. The 'Lowerface' section has a 'Smile' dropdown at '1,00', highlighted with a red box and a blue circle containing the number '1'. The 'Eye' section has a 'Look Right' dropdown at '2', highlighted with a blue box and a blue circle containing the number '2'. There are also 'Activate' and 'Auto Reset' checkboxes.

Can see the mouth movement at the cartoon and signal changing



Parts of the API: Expressiv™ Suite

▶ Interpreting graphs:

- *Blink*: low level = non-blink state / high level = a blink.
- *Right Wink / Left Wink*: share a common graph line.
Center level = no wink / low level = left wink /
high level = right wink.
- *Look Right / Left*: share a common graph line and a single sensitivity slider control.
A center level = looking straight ahead / low level = looking left
/ high level = looking right.
- *Raise Brow*: low level = no expression detected / high level = maximum level of expression detected.
The graph level will increase or decrease depending on the level of expression detected.

Parts of the API: ExpressivTM Suite



▶ Interpreting graphs:

- *Furrow Brow*: low level = no expression detected / high level = a maximum level of expression detected.
The graph level will increase or decrease depending on the level of expression detected.
- *Smile*: low level = no expression detected / high level = a maximum level of expression detected.
The graph level will increase or decrease depending on the level of expression detected.
- *Clench*: low level = no expression detected, high level = a maximum level of expression detected. The graph level will increase or decrease depending on the level of expression detected.

Parts of the API: ExpressivTM Suite



▶ Interpreting graphs:

- *Right Smirk / Left Smirk*: share a common graph line.
A center level = no smirk / low level = a left smirk / high level = a right smirk.
- *Laugh*: low level = no expression detected / high level = a maximum level of expression detected.
The graph level will increase or decrease depending on the level of expression detected.

Parts of the API: ExpressivTM Suite



▶ *Sensitivity Adjustment Panel:*

- This is controlled through sliders to the right of corresponding graph.
- For each facial expression, check the performance of the detection. If you feel that the Expressiv detection is not responding readily to a particular expression, then increase the sensitivity for that expression.

Parts of the API: Expressiv™ Suite



▶ *Training Panel:*

- Requires the user to train the system by performing the desired action before it can be detected.
- Trained Signature, the system will only detect actions for which the user has supplied training data.
- Not all Expressiv expressions can be trained. In particular, eye and eyelid-related expressions (i.e. “blink”, “wink”, “look left”, and “look right”) can not be trained and always rely on the Universal Signature.



Parts of the API: Affectiv™ Suite

- ▶ Reports real time changes in the subjective emotions experienced by the user.
- ▶ Offers 5 distinct Affectiv detections:
 - Engagement/Boredom
 - +Frustration
 - Instantaneous Excitement
 - +Meditation
 - Long-Term Excitement
- ▶ That characteristics are universal in nature and don't require an explicit training or signature-building step on the part of the user.
- ▶ It is **very important** that a new user profile is selected when a new user puts on the neuroheadset.

Parts of the API: Affectiv™ Suite



Emotiv Control Panel 0.8.0.0

Application Connect Help



SDK
0.8.0.0

ENGINE STATUS

System Status: Emotiv Engine is ready

System Up Time: 171.625

Wireless Signal: Good ●●●●

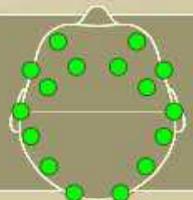
Battery Power: No Battery Meter Detected

USER STATUS

Headset: 0

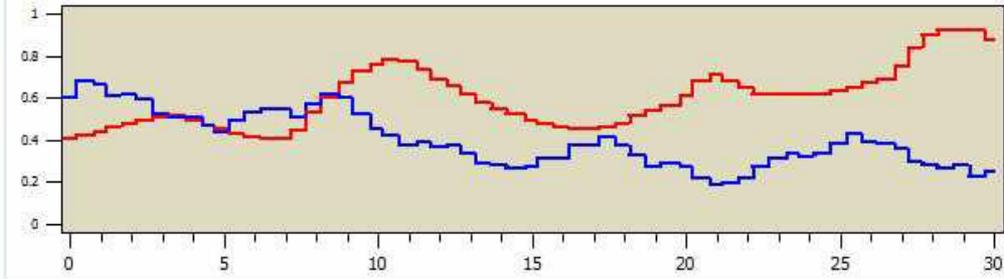
Profile: jw

Add Profile... Remove Profile Save Profile



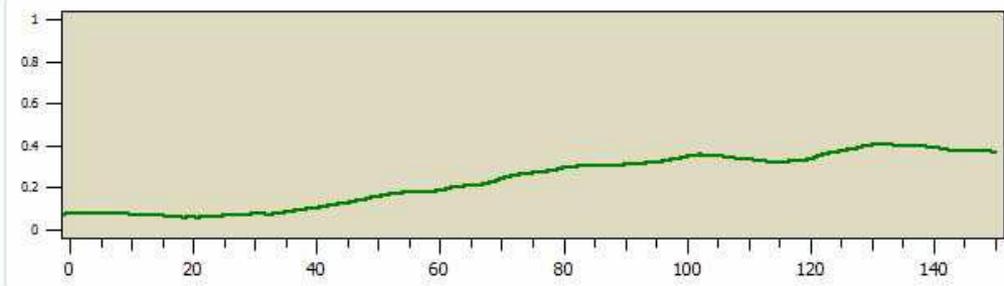
Headset Setup Expressiv Suite **Affectiv Suite** Cognitiv Suite

Status: OK...



Display Length 30 Seconds

Time (s)	Engagement/Boredom (red)	Instantaneous Excitement (blue)
0	0.4	0.65
5	0.45	0.5
10	0.75	0.4
15	0.5	0.3
20	0.6	0.35
25	0.65	0.3
30	0.9	0.25



Display Length 150 Seconds

Time (s)	Long Term Excitement (green)
0	0.05
20	0.05
40	0.1
60	0.2
80	0.3
100	0.35
120	0.3
140	0.4
150	0.35

Parts of the API: Affectiv™ Suite



▶ *Detection Details:*

- *Excitement* is characterized by activation in the sympathetic nervous system which results in a range of physiological responses including pupil dilation, eye widening, sweat gland stimulation, heart rate and muscle tension increases, blood diversion, and digestive inhibition.
- *Engagement* is characterized by increased physiological arousal and **beta** waves along with attenuated **alpha** waves. The opposite pole of this detection is referred to as "*Boredom*"



Parts of the API: Cognitiv™ Suite

- ▶ The Cognitiv detection suite evaluates a user's real time brainwave activity to discern the user's conscious intent to perform distinct physical actions on a real or virtual object.
- ▶ Is designed to work with up to 13 different actions: 6 directional movements (push, pull, left, right, up and down) and 6 rotations (clockwise, counter-clockwise, left, right, forward and backward) plus one additional action that exists only in the realm of the user's imagination: disappear.
- ▶ **NOTE:** allows the user to choose ONLY up to 4 actions that can be recognized at any given time.

Parts of the API: Cognitiv™ Suite



Parts of the API: Cognitiv™ Suite



ENGINE STATUS

System Status: EmoComposer connected
System Up Time: 225.169
Wireless Signal: Good
Battery Power: High

USER STATUS

Headset: 0 User: user
Add User... Remove User Save User

Headset Setup Expressiv Suite Affectiv Suite **Cognitiv Suite**

Action Training Advanced

Action Control

Current Action: **Neutral**
Detection Status: **Active**
Difficulty Level: **Moderate**
Overall Skill Rating: 0%

Trained?	Action	Skill Rating
✓	Push	0%
✓	Disappear	0%

+ Add - Remove Edit

You are now ready to control the cube with your mind! Each action skill rating reflects how well you can do the action. More training would increase your cognitive ability.

Action tab. Displays information about the current state of the Cognitiv detection and allows the user to define the current set of actions.

Parts of the API: Cognitiv™ Suite



Emotiv Control Panel 1.0.0.0-LITE

Application Connect Help

ENGINE STATUS

System Status: EmoComposer connected

System Up Time: 225.169

Wireless Signal: Good

Battery Power: High

USER STATUS

Headset: 0

Add User

SDK 1.0.0.0-LITE

Headset Setup Expressiv Suite Affectiv Suite **Cognitiv Suite**

Action Training

Action Control

Current Action: Neutral

Detection Status: Active

Difficulty Level: Moderate

Overall Skill Rating: 0%

Trained?	Action	Skill Rating
✓	Push	0%
✓	Disappear	0%

+ Add - Remove Edit

You are now ready to control the cube with your mind! Each action skill rating reflects how well you can do the action. More training would increase your cognitive ability.

Action tab. Displays information about the current state of the Cognitiv detection and allows the user to define the current set of actions.

All actions, plus Neutral (the user's background mental state) must be trained.

Parts of the API: Cognitiv™ Suite



ENGINE STATUS

System Status: EmoComposer connected
System Up Time: 225.169
Wireless Signal: Good ●●●●
Battery Power: High ●●●●

USER STATUS

Headset: 0
User: user
Add User... Remove User Save User

SDK 1.0.0.0-LITE

Headset Setup Expressiv Suite Affectiv Suite **Cognitiv Suite**

Action Training Advanced

Current Action: **Neutral**
Detection Status: **Active**
Difficulty Level: **Moderate**
Overall Skill Rating: 0%

Trained?	Action	Skill Rating
✓	Push	0%
✓	Disappear	0%

+ Add - Remove Edit

You are now ready to control the cube with your mind! Each action skill rating reflects how well you can do the action. More training would increase your cognitive ability.

Training process consists of three steps:
First, select an action from the dropdown list.

Parts of the API: Cognitiv™ Suite



Next, begin imagining or visualizing the action you wish to train, press the *Start Training* button. During the training process it is very important to maintain your mental focus for the duration of the training period (currently 8 seconds).

Parts of the API: Cognitiv™ Suite



Emotiv Control Panel 1.0.0.0-LITE

Application Connect Help

ENGINE STATUS

System Status: EmoComposer connected
System Up Time: 225.169
Wireless Signal: Good ●●●●
Battery Power: High ●●●●

USER STATUS

Headset: 0 User: user
Add User... Remove User Save User

Headset Setup Expressiv Suite Affectiv Suite **Cognitiv Suite**

Action Training Advanced

Current Action: **Neutral**
Detection Status: **Active**
Difficulty Level: **Moderate**
Overall Skill Rating: 0%

Trained?	Action	Skill Rating
✓	Push	0%
✓	Disappear	0%

+ Add - Remove Edit

You are now ready to control the cube with your mind! Each action skill rating reflects how well you can do the action. More training would increase your cognitive ability.

Some users will find it easier to maintain the necessary mental focus if the cube is automatically animated to perform the intended action as a visualization aid during training. Select the *Move cube according to training action* checkbox.



Parts of the API: Cognitiv™ Suite

- ▶ ***Training Neutral:***
 - ▶ The Neutral “action” refers to the user’s passive mental state; one that isn’t associated with any of the selected Cognitiv actions.
 - ▶ Typically this means engaging in passive mental activities such as reading or just relaxing.
- ▶ ***Advanced*** tab: It is strongly recommended that you only change these settings with the guidance of Emotiv personnel

Parts of the API: Cognitiv™ Suite



▶ *Tips:*

- Most users typically achieve their best results after training each action several times.
- Overtraining can sometimes produce a decrease in accuracy, this may also indicate a lack of consistency and mental fatigue.
- If it becomes hard for you to return to neutral, try refreshing your mental state by momentarily shifting your focus away from the screen and relaxing.

Emotiv SDK Tools: EmoKey™



- ▶ Translates Emotiv detection results to predefined sequences of keystrokes according to logical rules defined by the user through the EmoKey user interface.
- ▶ Can be saved for later reuse.
- ▶ Communicates with Emotiv EmoEngine in the same manner as would a third-party application: by using the Emotiv API exposed by edk.dll.

Emotiv SDK Tools: EmoKey™

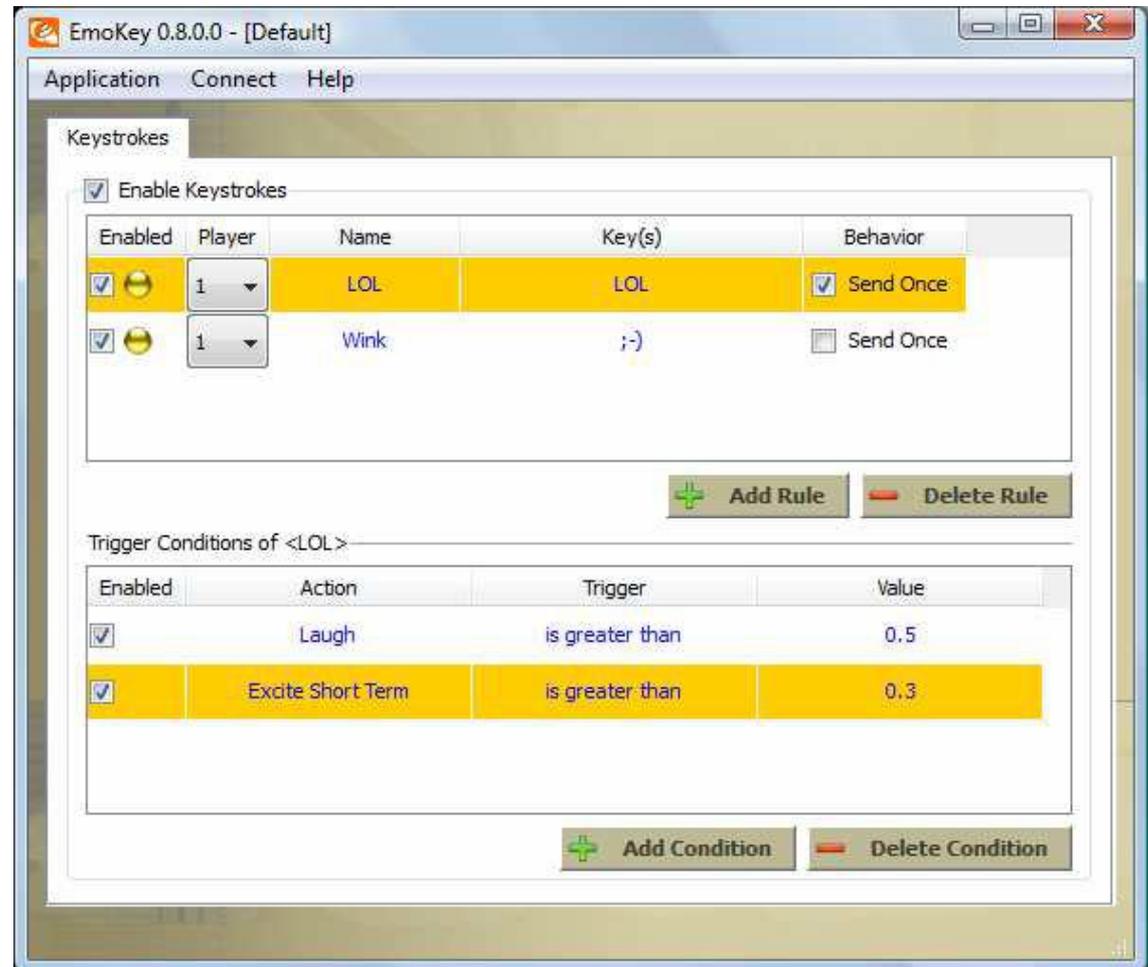


- ▶ *Connecting EmoKey to Emotiv EmoEngine:*
- ▶ By default, EmoKey will attempt to connect to Emotiv Control Panel when the application launches.
- ▶ Can also be connected to EmoComposer. Useful when creating and testing a new EmoKey Mapping.

Emotiv SDK Tools: EmoKey™



► *Configuring EmoKey Rules:*



Emotiv SDK Tools: EmoKey™



► *Configuring EmoKey Rules:*

Translate Laugh events
generated by Emotiv's Expressiv
Suite to ...

The screenshot shows the EmoKey 0.0 application window. The 'Application' tab is active, displaying a list of 'Keystrokes' with checkboxes for 'Enabled'. Below this, there are 'Add Rule' and 'Delete Rule' buttons. The 'Trigger Conditions of <LOL>' section contains a table with the following data:

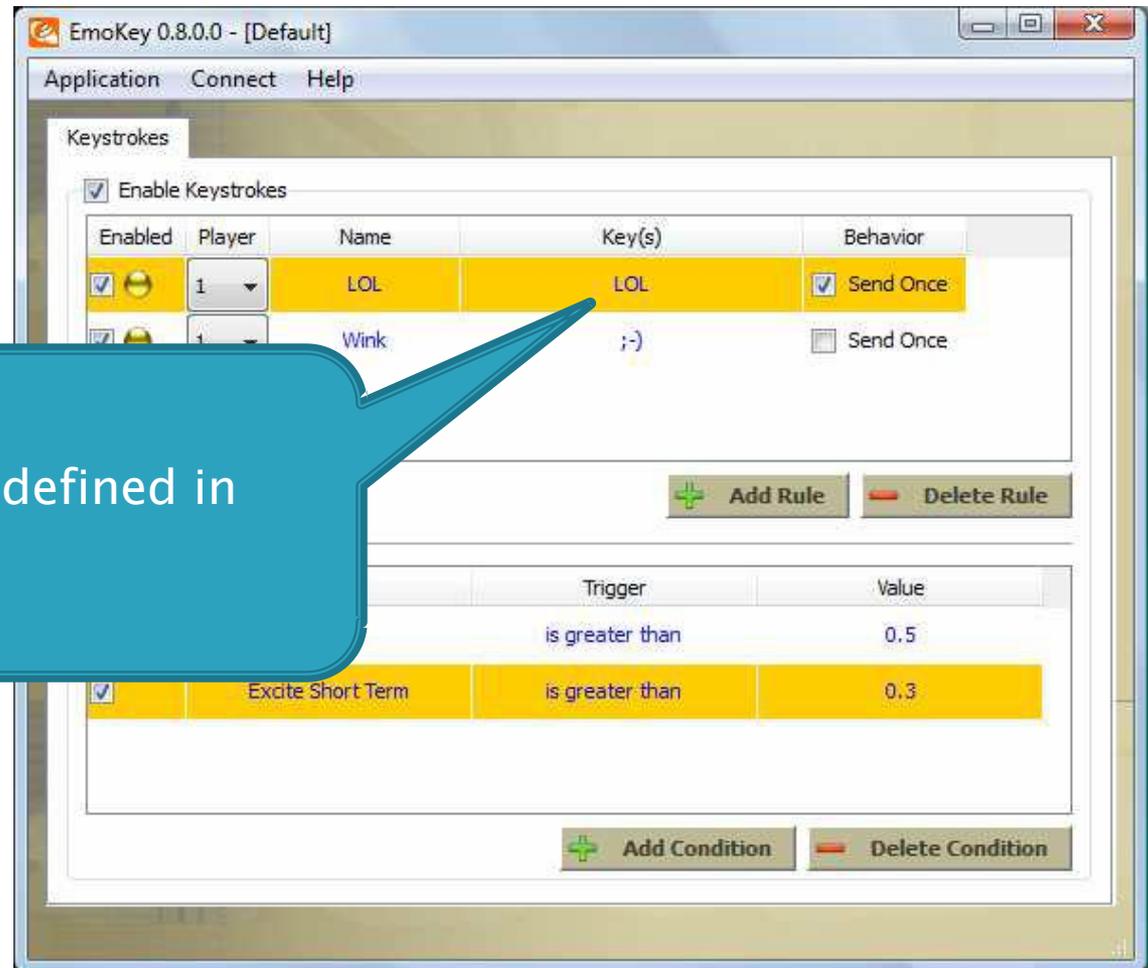
Enabled	Action	Trigger	Value
<input checked="" type="checkbox"/>	Laugh	is greater than	0.5
<input checked="" type="checkbox"/>	Excite Short Term	is greater than	0.3

At the bottom of the table, there are 'Add Condition' and 'Delete Condition' buttons.

Emotiv SDK Tools: EmoKey™



► *Configuring EmoKey Rules:*



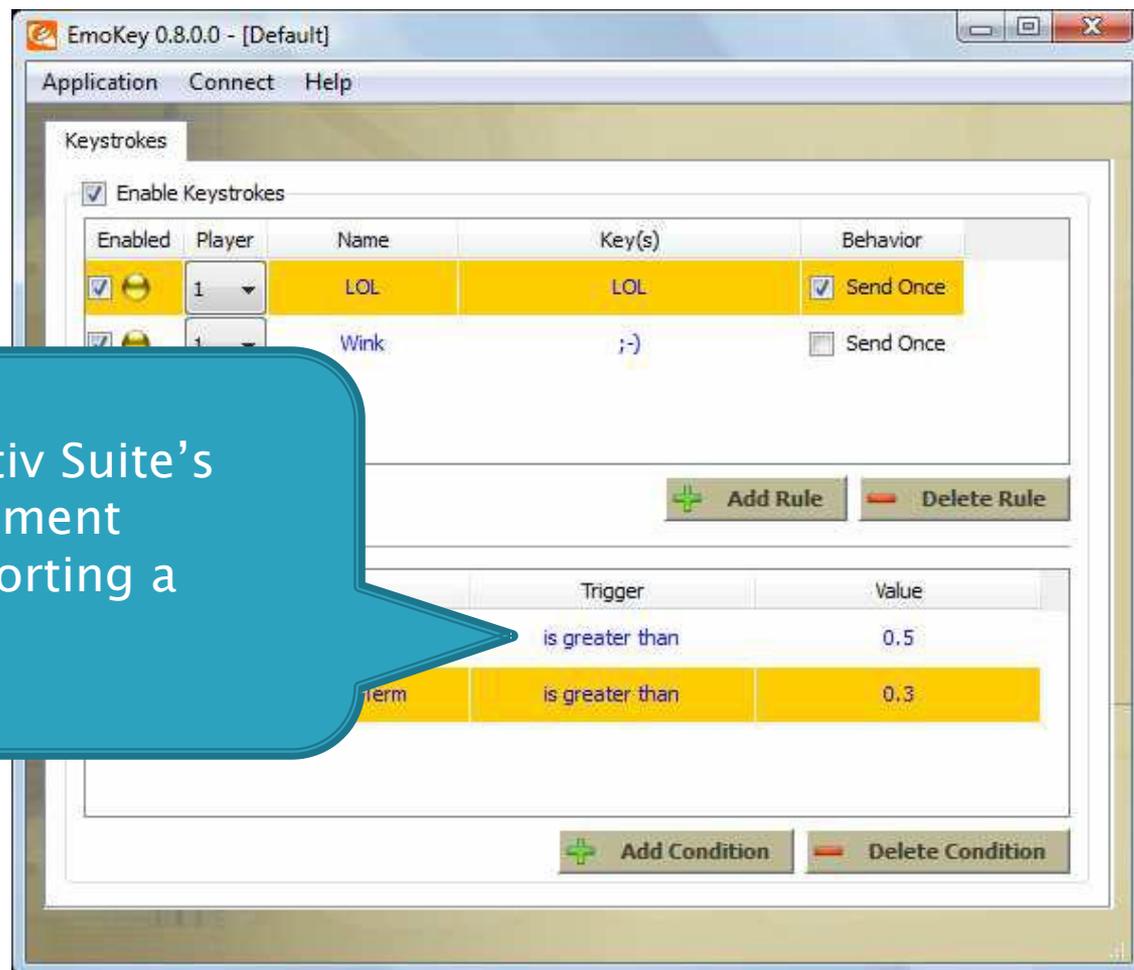
... to the text "LOL", defined in
"Key(s)"

Emotiv SDK Tools: EmoKey™



► *Configuring EmoKey Rules:*

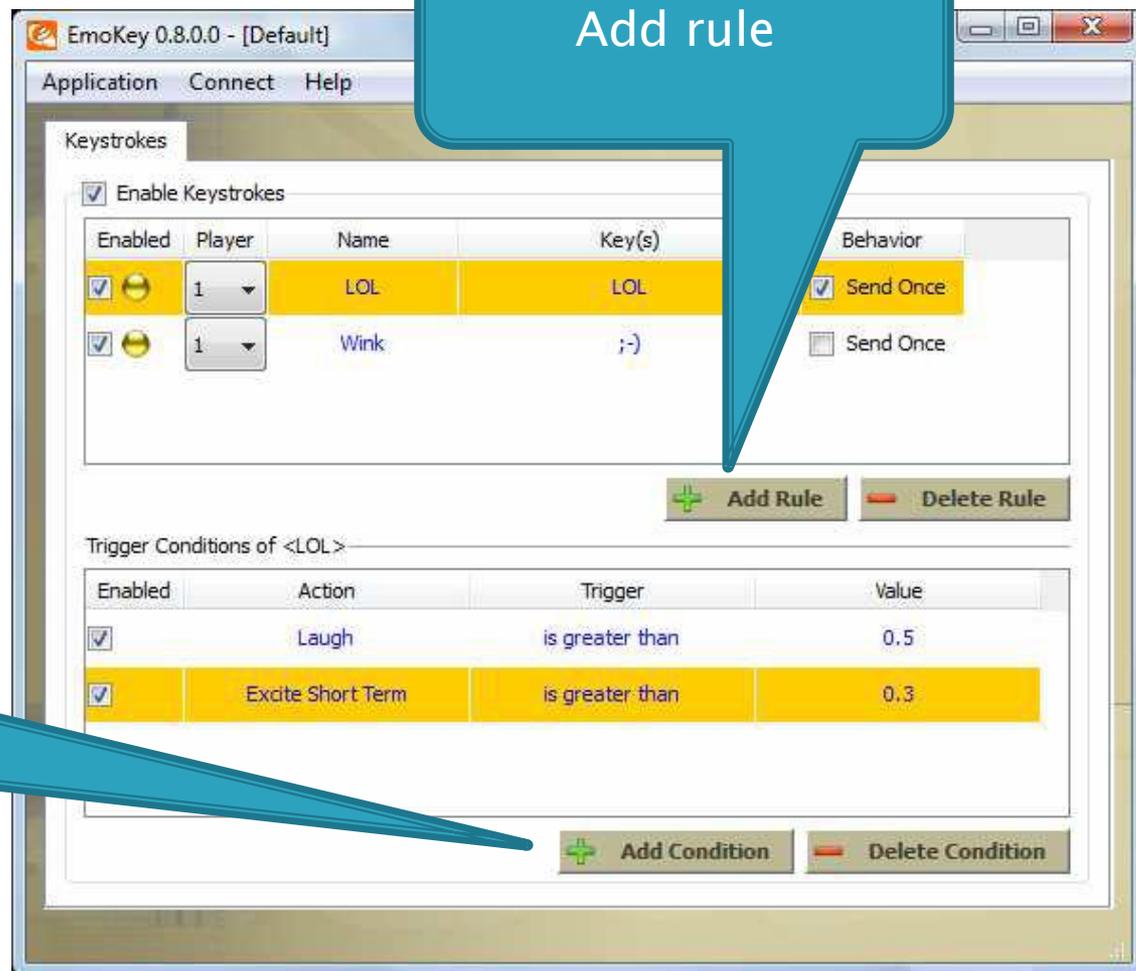
As long as the Affectiv Suite's
Instantaneous Excitement
detection is also reporting a
score > 0.5



Emotiv SDK Tools: EmoKey™



► *Configuring EmoKey Rules:*

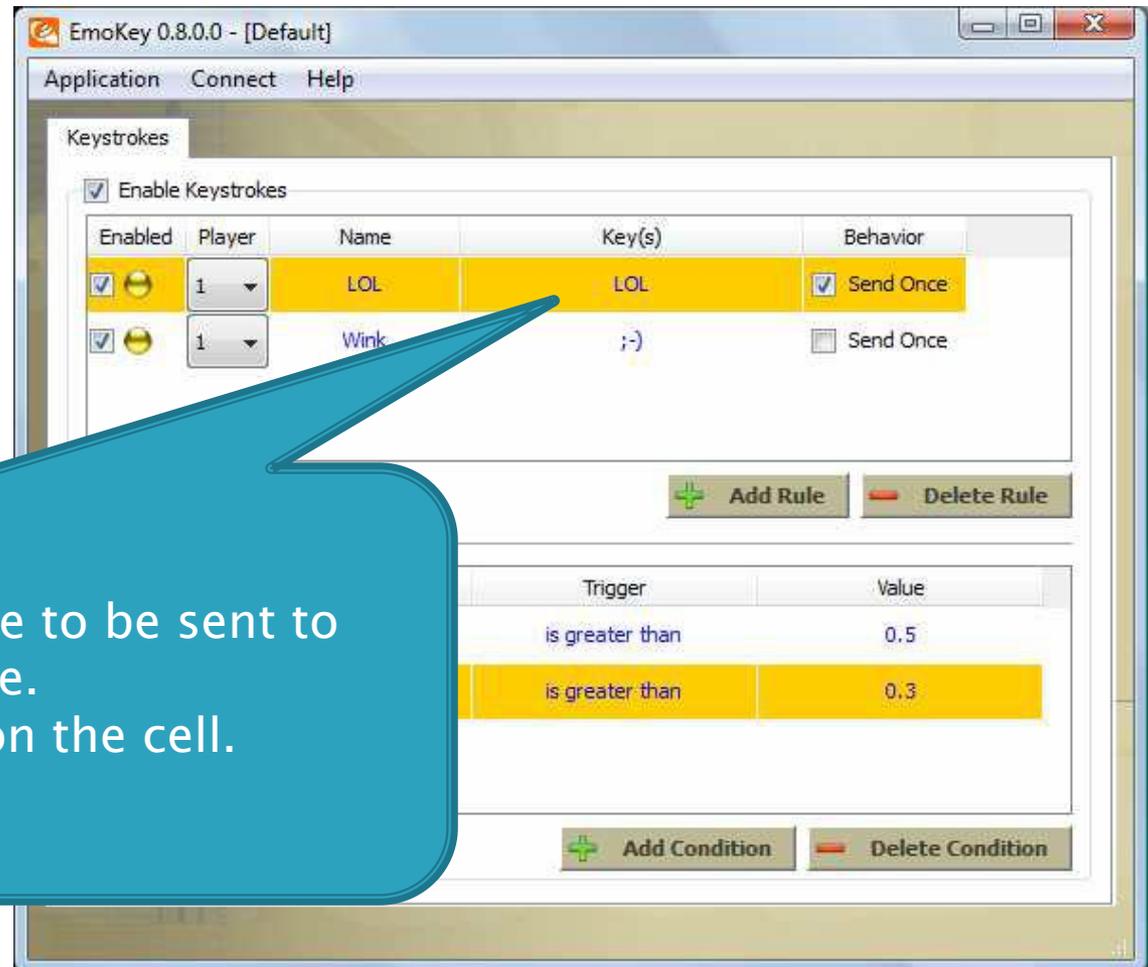


Add trigger conditions to the selected rule

Emotiv SDK Tools: EmoKey™



► *Configuring EmoKey Rules:*

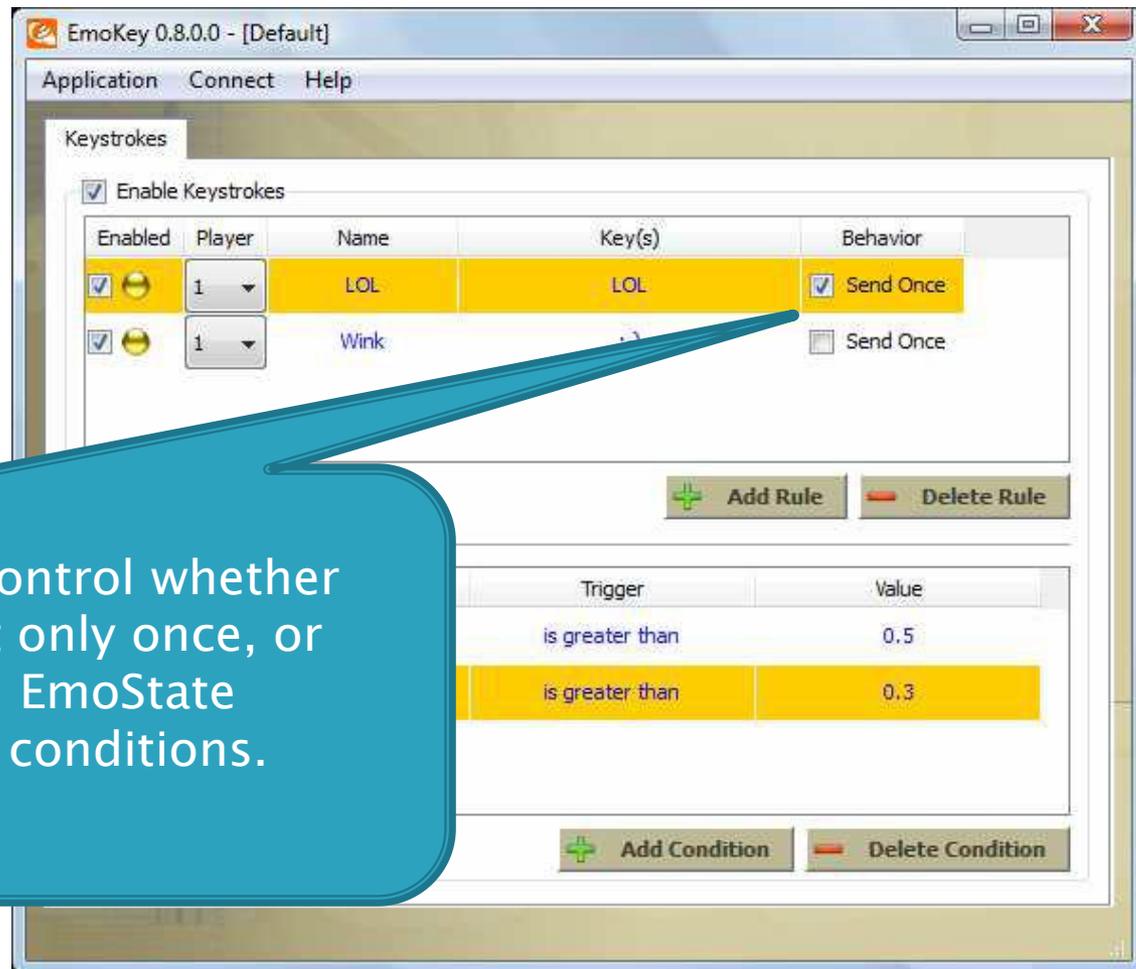


Key, Keystroke sequence to be sent to the Windows input queue.
Edit by double clicking on the cell.

Emotiv SDK Tools: EmoKey™



► *Configuring EmoKey Rules:*



Behavior Checkbox, to control whether the key sequence is sent only once, or repeatedly, each time an EmoState update satisfies the rule conditions.

Emotiv SDK Tools: EmoKey™



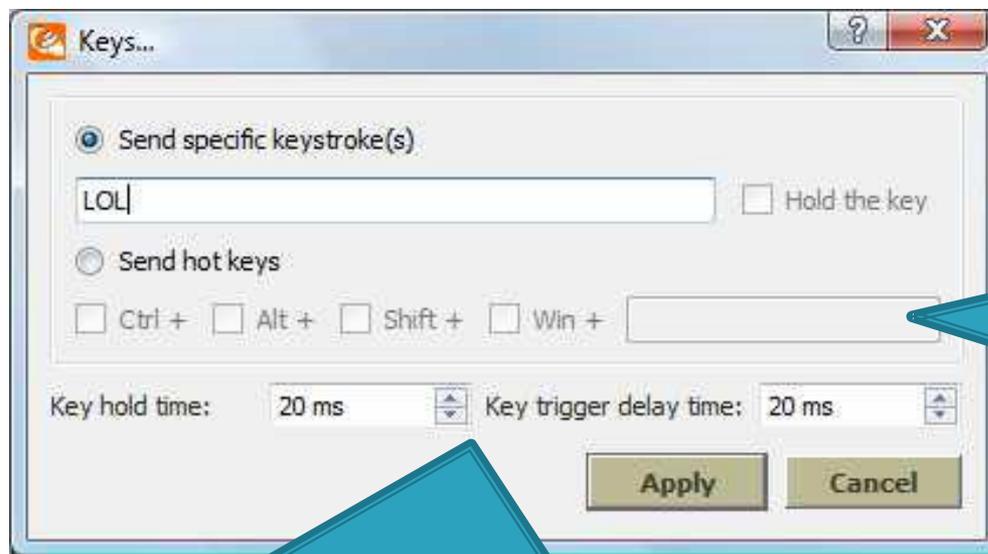
▶ *Configuring EmoKey Rules:*

- Emulates a Windows-compatible keyboard and sends keyboard input to the Windows operating system's input queue.
- The application with the input focus will receive the emulated keystrokes or other window you define.
- EmoKey is run in the background.

Emotiv SDK Tools: EmoKey™



► *Configuring EmoKey Rules:*



Hot keys or special keyboard keys: any combination of these, and another keystroke.

Key press duration and delay times: some applications, especially games, are sensitive to the timing of key presses.

Emotiv SDK Tools: EmoKey™



▶ *Saving Rules to an EmoKey Mapping file:*

- EmoKey allows you to save the current set of rule definitions to an EmoKey Mapping file.
- Example:

The screenshot shows the "Keystrokes" configuration window. At the top, there is a checkbox labeled "Enable Keystrokes" which is checked. Below this is a table with the following columns: "Enabled", "Player", "Name", "Key(s)", "Behavior", and "Target Application".

Enabled	Player	Name	Key(s)	Behavior	Target Application
<input checked="" type="checkbox"/>	1	Rule 1	:)	<input checked="" type="checkbox"/> Send Once	<To application in focus>

Below the table are two buttons: "+ Add Rule" and "- Delete Rule".

Underneath, there is a section titled "Trigger Conditions of <Rule 1>". It contains a table with the following columns: "Enabled", "Action", "Trigger", and "Value".

Enabled	Action	Trigger	Value
<input checked="" type="checkbox"/>	Smile	is equal to	1

At the bottom right of this section are two buttons: "+ Add Condition" and "- Delete Condition".

Emotiv SDK Tools: EmoKey™



▶ rule1.ekm:

```
<EmoMappingModel mappingName="rule1.ekm" > NAME
  <EmoMapping enabled="1" name="Rule 1" keys=":)"
    sendOnce="1" sendToFocus="1" targetApp="" (WHICH
APPLICATION WINDOW) sendHotKeys="0" ctrlKey="0" altKey="0"
    shiftKey="0" winKey="0" hotKey="0" holdKey="0"
    holdTime="20" triggerDelayTime="20" (VARIABLES)player="0">
    <EmoStateCondition> (TRIGGER)
      <enabled value="1" />
      <action value="7" /> (7=Smile)
      <threshold type="double" value="1" />
      <actionRule value="0" /> (0=is equal to)
    </EmoStateCondition>
  </EmoMapping>
</EmoMappingModel>
```



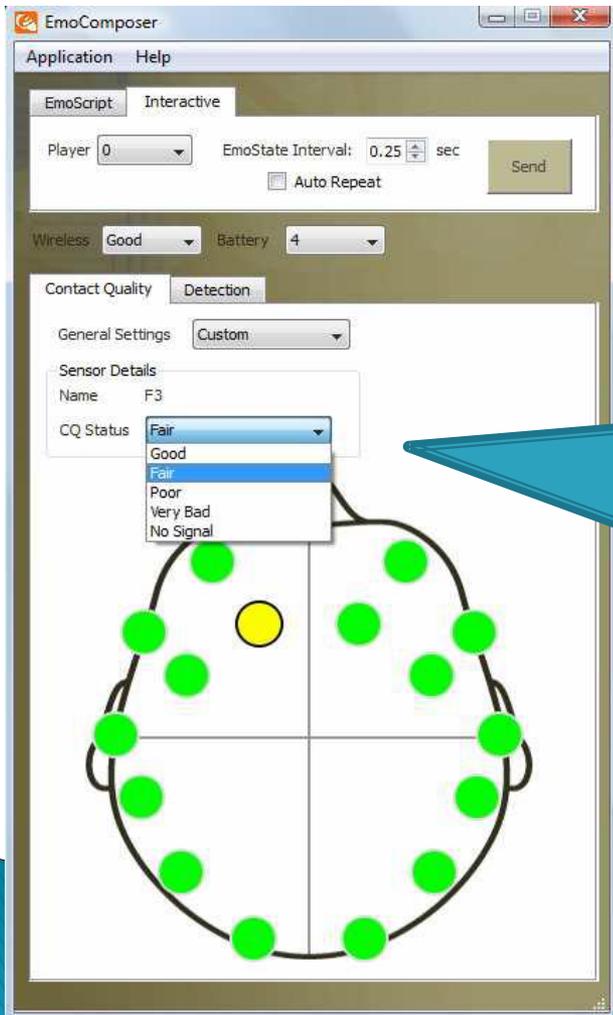
Emotiv SDK Tools: EmoComposer™ usage

- ▶ Allows you to send user-defined EmoStates™ to Emotiv Control Panel, EmoKey, or any other application that makes use of the Emotiv API.
- ▶ Two modes:
 - Interactive mode
 - EmoScript mode
- ▶ SDKLite users will rely on EmoComposer to simulate the behavior of Emotiv EmoEngine and Emotiv neuroheadsets.

Emotiv SDK Tools: EmoComposer™ usage



► *Interactive mode:*



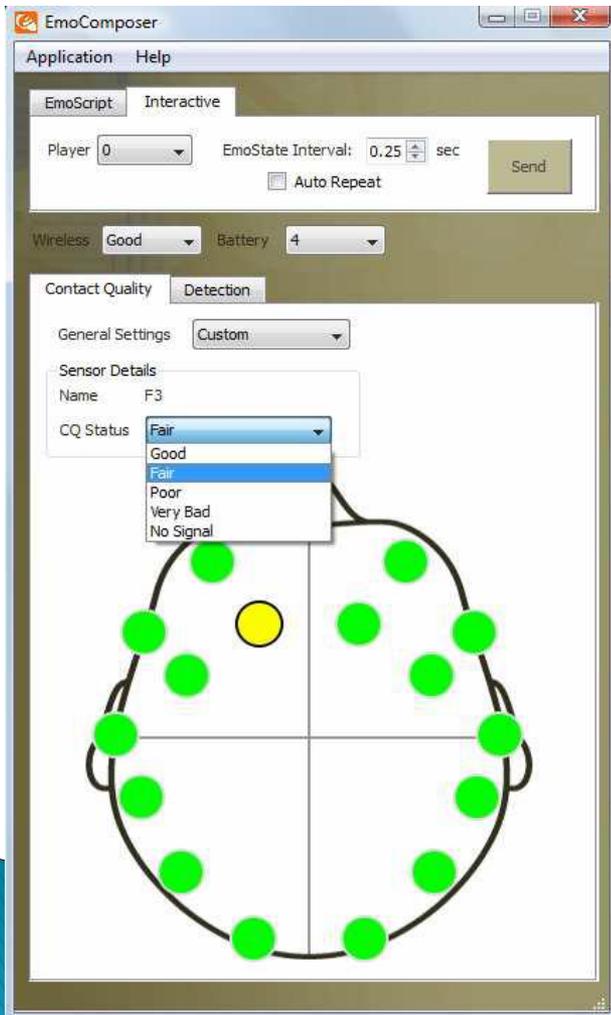
Reported
contact
quality for
each sensor



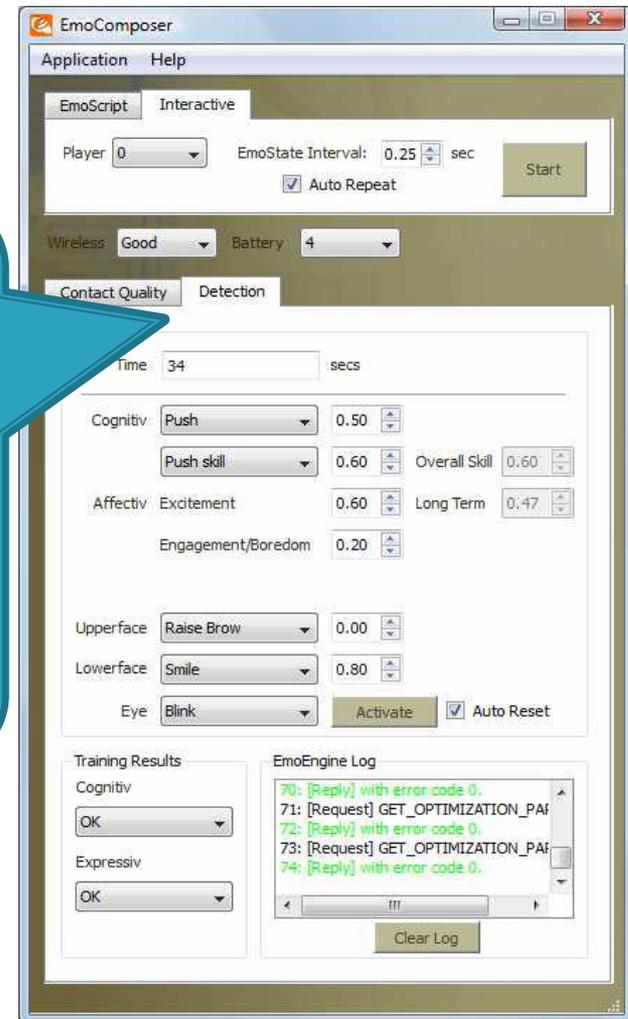
Emotiv SDK Tools: EmoComposer™ usage



► *Interactive mode:*



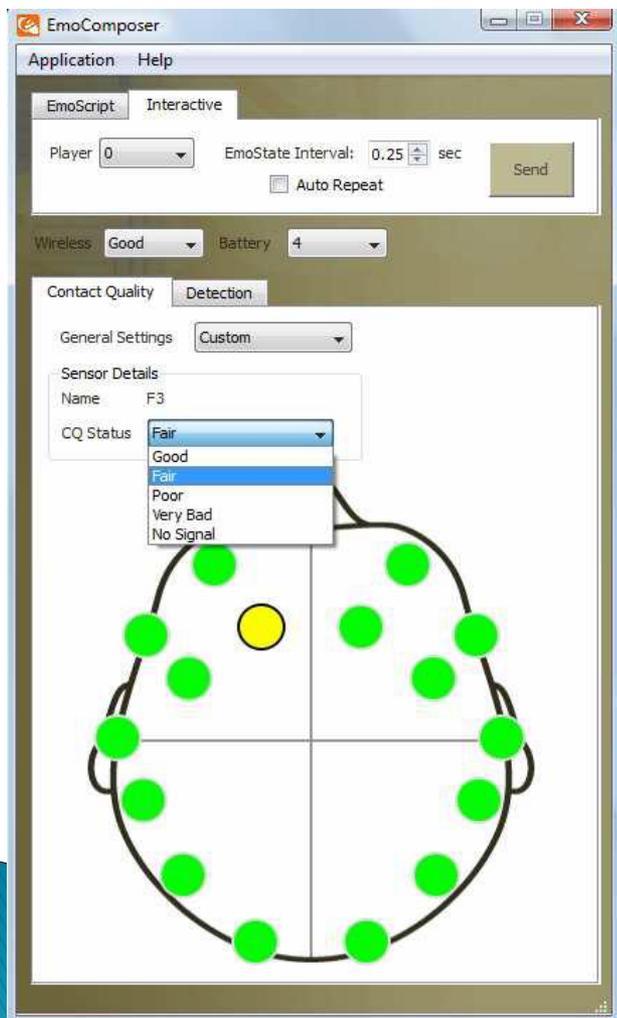
Interactively
control
EmoState™
detection
values
and training
result
values.



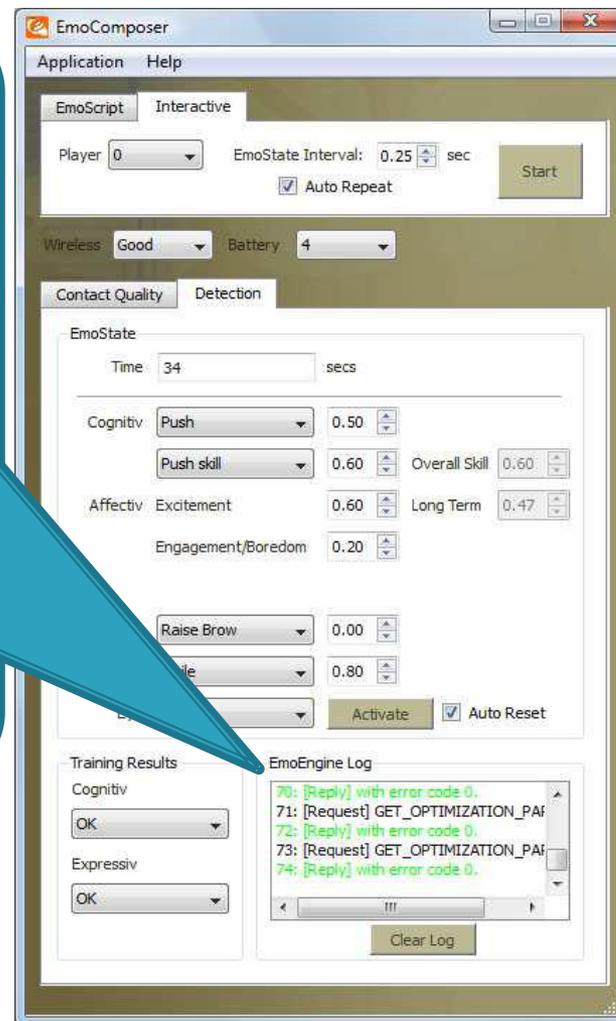


Emotiv SDK Tools: EmoComposer™ usage

► *Interactive mode:*



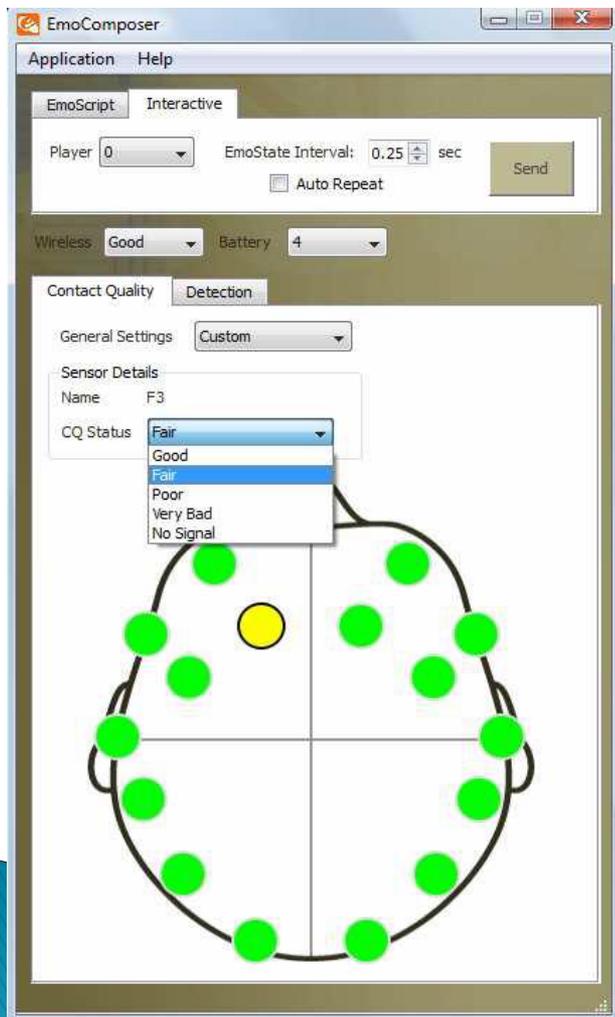
Give developers a clearer picture about how processes requests generated by various Emotiv API functions.



Emotiv SDK Tools: EmoComposer™ usage



► *Interactive mode:*



3 different
output types:
– Request
– Reply
– CogResult
or ExpResult





Emotiv SDK Tools: EmoComposer™ usage

- ▶ The multitude of API functions are translated to roughly a dozen different strings intended to allow the Emotiv SDK developer to see that an API function call has been serviced.
- ▶ These strings include:
PROFILE_ADD_USER, PROFILE_CHANGE_USER,
PROFILE_REMOVE_USER, PROFILE_LIST_USER,
PROFILE_GET_CURRENT_USER, PROFILE_LOAD, PROFILE_SAVE,
EXPRESSIV_GET, EXPRESSIV_SET, AFFECTIV_GET,
AFFECTIV_SET, COGNITIV_SET and COGNITIV_GET.



Emotiv SDK Tools: EmoComposer™ usage

▶ *EmoScript Mode:*

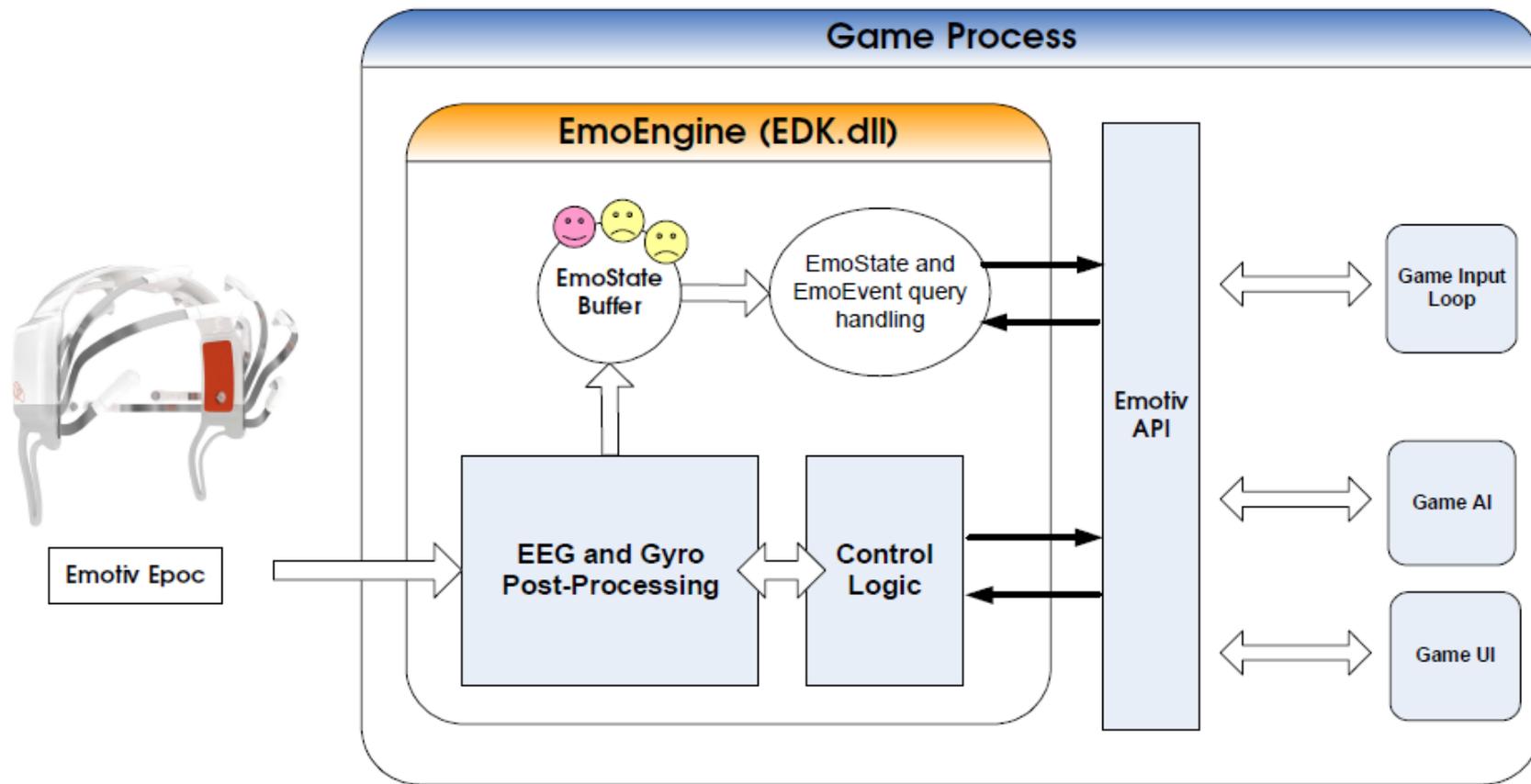
- EmoScript files are written in EML (EmoComposer™ Markup Language). EML documents are XML documents that can be interpreted by EmoComposer.
- Note that these EmoScript values are not interactive and can not be modified by the user (use the Interactive mode for this instead).

Programming with the Emotiv SDK



- ▶ Program in C++ and compiled with Microsoft Visual Studio 2005 (Visual Studio 2008 is also supported).
- ▶ The Emotiv API is exposed as an ANSI C interface that is declared in 3 header files (edk.h, EmoStateDLL.h, edkErrorCode.h) and implemented in 2 Windows DLLs (edk.dll and edk_utils.dll).
- ▶ Applications simply include edk.h and link with edk.dll.
- ▶ Emotiv API functions that modify or retrieve EmoEngine settings are prefixed with "EE_."
- ▶ An EmoState is an opaque data structure that contains the current state of the Emotiv detections, which, in turn, reflect the user's facial, emotional and cognitive state. ("ES_.")

Programming with the Emotiv SDK





Programming with the Emotiv SDK

Must establish a connection to the EmoEngine by calling `EE_EngineConnect` or *`EE_EngineRemoteConnect`*.

Events that can be retrieved by calling `EE_EngineGetNextEvent()`. For near real-time responsiveness should poll for new EmoStates at least 10–15 times per second.

Before your application terminates, the connection to EmoEngine should be explicitly closed by calling `EE_EngineDisconnect()`.

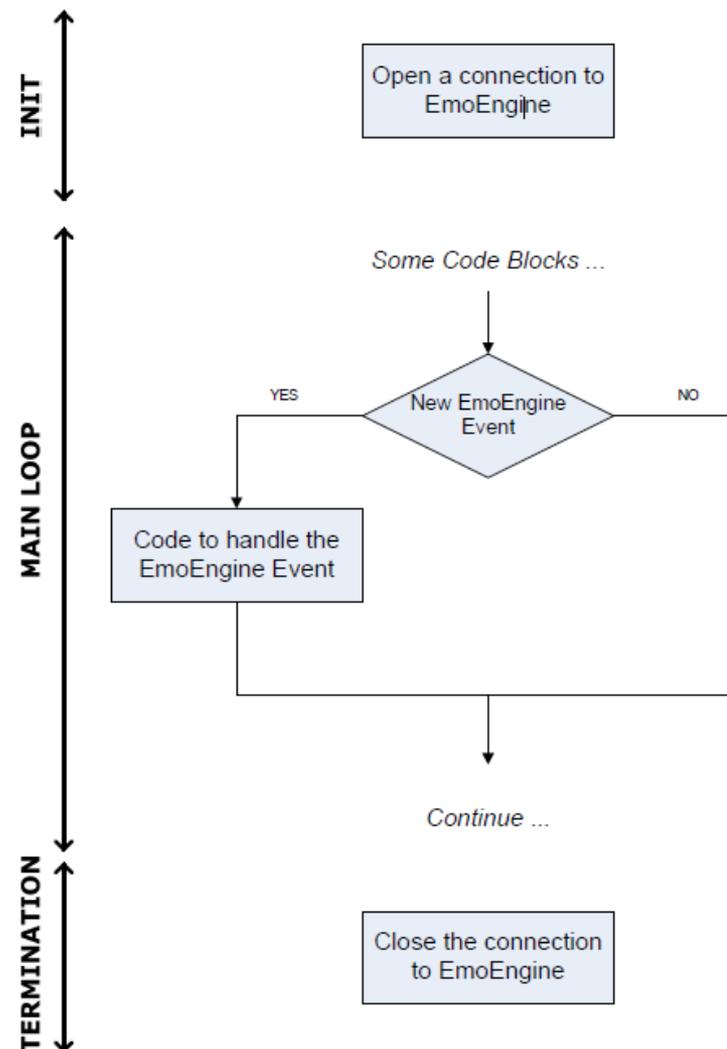


Figure 21 Using the API to communicate with the EmoEngine

Programming with the Emotiv SDK



- ▶ 3 main categories of EmoEngine events:
 - Hardware-related events: when users connect or disconnect Emotiv input devices to the computer (e.g. EE_UserAdded).
 - New EmoState events: changes in the user's facial, cognitive and emotional state. retrieve the updated EmoState by calling EE_EmoEngineEventGetEmoState(). (e.g. EE_EmoStateUpdated).
 - Suite-specific events: training and configuring the Cognitive and Expressive detection suites (e.g. EE_CognitiveEvent).
- ▶ **NOTE:** A complete list of all EmoEngine events can be found in Appendix 3 (User Manual)

Programming with the Emotiv SDK



- ▶ **Scenarios Supported by EE_EngineRemoteConnect:**
(in place of EE_EngineConnect())
- ▶ Developing with Emotiv SDKLite; not include an Emotiv headset so all Emotiv API function calls communicate with EmoComposer. It listens on port 1726 so an application that wishes to connect to an instance of EmoComposer running on the same computer must call `EE_EngineRemoteConnect(127.0.0.1, 1726)`.
- ▶ Testing application's behavior, the same connection.
- ▶ Developer wants to speed the development process by beginning his application integration with the EmoEngine and the Emotiv headset without having to construct all of the UI and application logic required. Emotiv Control Panel can act as a proxy for either the real, headset-integrated EmoEngine or EmoComposer. Control Panel listens on port 3008 so, must call `EE_EngineRemoteConnect(127.0.0.1, 3008)`.

Programming with the Emotiv SDK



```
// ... print some instructions...
std::string input;
std::getline(std::cin, input, '\n');
option = atoi(input.c_str());

switch (option) {
    case 1: {
        if (EE_EngineConnect() != EDK_OK) {
            throw exception("Emotiv Engine start up failed.");
        }
        break;
    }
    case 2: {
        std::cout << "Target IP of EmoComposer? [127.0.0.1] ";
        std::getline(std::cin, input, '\n');
        if (input.empty()) {
            input = std::string("127.0.0.1");
        }
        if (EE_EngineRemoteConnect(input.c_str(), 1726) != EDK_OK) {
            throw exception("Cannot connect to EmoComposer!");
        }
        break;
    }
    default:
        throw exception("Invalid option...");
        break;
}
```

Listing 1 *Connect to the EmoEngine*

Programming with the Emotiv SDK



```
EmoEngineEventHandle eEvent= EE_EmoEngineEventCreate();
EmoStateHandle eState      = EE_EmoStateCreate();
unsigned int userID        = 0;
while (...) {
int state = EE_EngineGetNextEvent(eEvent);
// New event needs to be handled
if (state == EDK_OK) {
    EE_Event_t eventType = EE_EmoEngineEventGetType(eEvent);
    EE_EmoEngineEventGetUserId(eEvent, &userID);
    // Log the EmoState if it has been updated
    if (eventType == EE_EmoStateUpdated) {
        // New EmoState from user
        EE_EmoEngineEventGetEmoState(eEvent, eState);
        // Log the new EmoState
        logEmoState(ofs, userID, eState, writeHeader);
        writeHeader = false;
    }
}
}
```

Listing 2 *Buffer creation and management*



Programming with the Emotiv SDK

- ▶ Before the end of the program, `EE_EngineDisconnect()` is called to terminate the connection with the EmoEngine and free up resources associated with the connection.
- ▶ The user should also call `EE_EmoStateFree()` and `EE_EmoEngineEventFree()` to free up memory allocated for the EmoState buffer and `EmoEngineEventHandle`.

```
EE_EngineDisconnect ();  
EE_EmoStateFree (eState) ;  
EE_EmoEngineEventFree (eEvent) ;
```

Listing 3 *Disconnecting from the EmoEngine*



References

- ▶ <http://emotiv.com/store/sdk/edition/sdklite/>
SDKLite developers will download the compressed file Emotiv_SDKLite_v1.0.x.exe, which contains both the SDKLite software and the User Manual.
- ▶ <https://jira.ai2.upv.es/confluence/display/LOTO/2011/10/25/WGM+35.+EEG+Control+%28I%29>

Previous presentation