Revolutionary next generation human computer interaction
Emotiv Systems Inc. is a neuroengineering company developing the next phase of **man-machine interface**

We are releasing a consumer product that offers a uniquely **personal experience** in the areas of:

- Games & Entertainment
- MMOGs
- Online Virtual Worlds
- Accessibility
- Semantic Application Interface

Emotiv’s breakthrough neurotechnology platform enables a whole new realm of interaction
60-100 million people globally are participating in virtual worlds

Average age of users: 26 years old (Second Life: 33), only 25% are teens

Virtual worlds are on the verge of going mainstream

In 2008/09 Virtual Worlds
• Will become more like social networks
• Social networks will become social experiences
• Convergence consoles and PCs in online space

Facial expression & emotional feedback are critical hurdles to mainstream adoption of 3D virtual worlds
Our headset enables you to interact directly with elements on screen using the power of your brain. Facial expressions are detected naturally, in real-time—allowing Avatars to come to life without conscious involvement.

By understanding the emotional experience of the user, content can be adjusted dynamically to reflect excitement, engagement, calmness, tension, and frustration. Players learn to control objects by thought—giving them the sensation of “the Force.”

Designed to complement existing controllers, Emotiv provides an intuitive, highly immersive and natural extension of the user experience.
In 2008, Emotiv will release the **Epoc** Neuroheadset

Complete, out-of-the-box entertainment experience

Control the universe with your mind through a game uniquely designed for the Emotiv headset

Extend the headset features to any game in your existing collection of PC games through **Emokey** software

Download and experience new detections for the headset through our web platform

Consumer product includes a game designed for the headset as well as tools to allow it to be used with existing game and applications
Emotiv Neuroheadset

Combines low powered wireless communication with a high fidelity signal acquisition system to produce a practical, light weight consumer product.

Self adjusts to fit most head shapes and sizes.

Features optimal sensor positioning that offers accurate, spatial resolution of the brain.

Incorporates high performance wireless connectivity.

A gyroscope to control avatar head or cursor movement.

Stylish, wireless, high fidelity, consumer EEG signal acquisition headset.
Era of Graphics

For the past 30 years game development has been focused on improved graphics and sound.

Graphics continue to evolve but with disproportional effort and diminished return on value.

Computer interface has hardly progressed.

Until recently, innovations in other areas have suffered.

Graphic realism has been the focus of innovation in game design.
Innovation in gaming interface has not kept pace with graphics evolution

Comparison Timeline:

PAST

PRESENT

Innovation in gaming interface has not kept pace with graphics evolution
Dance Dance Revolution – 1999
‘Buttons’ are located on the floor, allow player to act out moves

EyeToy - 2003
Camera captures the player’s movement by stripping video image from background and allows interaction via edge detection

Guitar Hero - 2005
Like DDR, player participates in a way more consistent with the fantasy
Nintendo Wii – Introduced Fall 2006

Interactivity trumps graphics performance

Natural interface demonstrates mass market appeal

Sales outperforms competition and device continues to be out of stock in stores 1 ½ years after introduction
Brain Computer Interface is the ultimate semantic device.

Taps into the human ‘control center’

Emotions and non-conscious thoughts can be detected before you’re even aware.

Multichannel Human Computer Interface allows traditional input of conscious control while providing a feedback loop based on user perception.

Information about the user’s experience can be used to modify content and tailor experience.
EEG (Electroencephalography)

- Low latency
- Portable
- Inexpensive
- Passive & Non-invasive

Neural Feedback: how it works

- Brain
- Mental Preferences
- Complex Brainstates
- Head sensor
  Electrical activity from brain and skin on head measures strength of desired brainstate.

Monitor
- Game Software
Emotiv has released three classes of detection using our neuroheadset:

- **Expressiv** – Identifies facial expressions
- **Affectiv** – Detects emotional states
- **Cognitiv** – Classifies conscious, active intent
Emotiv Detection Suites:

EXPRESSIV: *facial expressions*
- MMOG, Social Networks, AI characters --- become more humanly interactive

AFFECTIV: *feelings & emotions*
- Dynamic difficulty adjustment, feedback loop --- enables media to react to individual emotional engagement and adjust play accordingly

COGNITIV: *telekinesis*
- Lift, rotate, push... --- fulfills a powerful fantasy that crosses all cultures; beyond anything previously thought possible
Emotiv SDK

Enables game developers to deliver content for the Emotiv platform

Emulation tools allow for rapid prototyping of existing applications

Composer allows for off-line simulation of headset input

Downloadable SDKLite provides immediate access to Emulation and Composition tools
Levels of Software Integration:

- **Rapid integration into existing and emerging applications via traditional input device emulation**
  - Detection outputs (or combinations of outputs) are mapped to keystrokes which trigger events in the application
  - User setup is performed outside the target application
  - Initial integration in just minutes

- **Complete integration via API (edk.dll)**
  - The technology is fully integrated via a dynamically linked library and accessed thru a concise set of function calls (api)
  - Setup can be integrated into the application
    - Example: instead of training in the control panel, Harry Potter would go to wizard school and learn his spells to train the cognitive actions
    - Profiles can be managed by the application’s own user profile
Emotiv Beta SDK

- **Hardware**
  - Headset
  - Charger (power outlet or USB)
  - Headset battery life greater than 10 hours

- **Software CD**
  - User manual
  - Emotiv Development DLL (edk.dll)
  - API reference documentation
  - Example projects (c++ source code)
  - Control Panel
    - Supports 2 players
    - Includes hardware status and user profile management
    - Exposes detection suites in action
  - Development Tools
    - EmoKey – Headset interface via keyboard emulation
    - EmoComposer – Brain state emulation
    - EmoScript examples
Rapid Integration

EmoKey
- Converts detection events into signals that emulate traditional input devices
  - Simple events: Smile > 50% triggers ":)" keystrokes
  - Compound events: Smile > 50% + wink triggers ";)"
  - Simulated keystrokes can be triggered:
    - Once only (both hold and release time may be specified)
    - Repeatedly, while a mapping condition is met (both hold and release times between strokes may be specified)
- Emokey profiles can be saved for each application
- Common modifiers (shift, alt, ctrl) can also be used to create complex keystroke combinations.
- Implementation time in the order of minutes
Emotiv SDK – Complete Integration

host platform

wireless receiver → device driver → emoengine → api interface → api calls

emotiv sdk library (edk.dll)

application
Complete Integration:

- **Hardware and user management**
  - Integrated into the menu system of the application
  - Combined with other service routines
    - Controller configurations
    - Difficulty settings

- **Detections and Training**
  - Detections matched to the content and fantasy of the application
  - Unified train and play environments facilitate more rapid and entertaining training
  - Inclusion of new content and interactivity enabled by access to the detection suite output, for example:
    - Dynamic difficulty adjustment (Affectiv)
    - Real time personalized avatars (Expressiv)
    - New and more amazing super powers, mind powers or abilities (Cognitiv)

- **Development and testing tools**
  - EmoKey
  - EmoComposer
Emotiv SDK Function Classes

- **EE_ Prefix**
  - Status, calibration & profile functions

- **ES_ Prefix**
  - Detection suite access

Emotiv SDK Core Objects

- **EmoEngine Event Object**
  - Alerts to events such as new detection states being available

- **EmoEngine State Object**
  - Contains the status of hardware, software and detection suite outputs.

Profile commands
Calibration commands
Detection queries

System status
Detection results
Each user has a unique profile to store:

- Expressiv sensitivities and ranges
  - Sensitivity specifies ease to trigger a detection
    - For example, smile may be triggered when the user is just starting to smile, or when they have a large grin
  - Range specifies how broad the detection is after onset
    - Low range: detections slightly above onset go to full scale
    - High Range: detections must be triggered far above the onset level to trigger full scale

- Cognitiv training data
  - Data from training to classify their individual brainwave ‘signature’, for each focussed and intent thought trained, as well as neutral
Emotiv SDK – API Usage

create core objects
- ES_Create
- EE_EmoEngineEventCreate

connect to the emoengine
- EE_EngineConnect

respond to events
- Examples: New EmotState
- New user
- Profile selection

query for new events
- EE_EngineGetNextEvent
- EE_EmotEngineEventGetGetType
- EE_EmotEngineEventGetUserId

disconnect from the emoengine
- EE_EngineDisconnect

free core objects
- ES_Free
- EE_EmoEngineEventFree
Events in the Emotiv SDK

- **EE_UserAdded / EE_UserRemoved**
  - New user registered with or removed from the emoengine, respectively.

- **EE_ProfileEvent**
  - Profile access events, such as the return of the requested profile for a new user.

- **EE_CognitivEvent**
  - Dedicated to events in the cognitiv suite, most importantly control of training

- **EE_EmoStateUpdated**
  - New detection event, such as a new facial expression.
## Detection Result Types

<table>
<thead>
<tr>
<th>Detection</th>
<th>EmoState Query</th>
<th>Result Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blink</td>
<td>ES_ExpressivIsBlink</td>
<td>Binary (integer 0 or 1)</td>
</tr>
<tr>
<td>Wink (Left or Right)</td>
<td>ES_ExpressivIsLeftWink / ES_ExpressivIsRightWink</td>
<td>Binary (integer 0 or 1)</td>
</tr>
<tr>
<td>Horizontal Eye Movement (Left or Right)</td>
<td>ES_ExpressivIsLookingLeft / ES_ExpressivIsLookingRight</td>
<td>Binary (integer 0 or 1)</td>
</tr>
<tr>
<td>Smile</td>
<td>ES_ExpressivGetSmileExtent</td>
<td>Continuous (float) (101 increments, from 0.00 to 1.00)</td>
</tr>
<tr>
<td>Clench</td>
<td>ES_ExpressivGetClenchExtent</td>
<td>Continuous (float) (101 increments, from 0.00 to 1.00)</td>
</tr>
<tr>
<td>Eyebrow movement</td>
<td>ES_ExpressivGetEyebrowExtent</td>
<td>Continuous (float) (101 increments, from 0.00 to 1.00)</td>
</tr>
<tr>
<td>Short Term Excitement / Calmness</td>
<td>ES_AffectivGetExcitementShortTermScore</td>
<td>Continuous (float) (101 increments, from most calm at 0.00 to most excited at 1.00)</td>
</tr>
<tr>
<td>Long Term Excitement / Calmness</td>
<td>ES_AffectivGetExcitementLongTermScore</td>
<td>Continuous (float) (101 increments, from most calm at 0.00 to most excited at 1.00)</td>
</tr>
<tr>
<td>Cognitiv Action (Up to 4)</td>
<td>ES_CognitivGetCurrentAction</td>
<td>Continuous (float) (101 increments, from low power at 0.00 to full strength at 1.00)</td>
</tr>
</tbody>
</table>
EmoComposer

- Hardware emulator which can be used in place of the headset to simulate both the presence of the hardware as well as detection suite outputs
- Two modes of operation:
  - Interactive mode: events triggered and adjusted via on-screen controls. Events of all types including detection outputs, training sequences and profile management are supported
  - Script mode: timed sequence of events played back from pre-defined descriptions written in EmoScript, a simple markup language file
- Removes the need for each developer/designer to have a headset, thereby removing the potential bottleneck on headset access
- Enables rapid and automated testing for both development and quality assurance. Extensive scripting options are supported to facilitate rigorous testing of common and boundary conditions
- Interaction mirrors the real api architecture in calling convention and response.
Sample Development Process – Phase 1

development & testing platform

EmoCompose

EmoScript (eml)

EmoStates

application
edk.dll
Sample Development Process – Phase 2

development & testing platform

wireless receiver → edk.dll → application
Training the Cognitiv Suite

- The Cognitiv suite is trained by recording:
  - Neutral: a background state, recorded when the user is not performing expressions or cognitiv actions
  - Actions: recordings of the user focusing their intent on an action for about 8 seconds

- Subsequent training helps the system learn to identify the user’s brainwaves, and helps the user learn to focus on the actions

- An application must alert the EmoEngine when to start recording the user’s brainwaves, and which with cognitiv state to associate them. A dedicated event class returns training status

- If the user is distracted, they may discard their last recording. If the signals are noisy, it is automatically discarded

- Up to four actions are available at any one time, the number available is referred to as the current level of the user
Training the Cognitiv Suite

- **start training**
  - EE_CognitivSetTrainingAction
  - EE_CognitivTrainingControl(userId, COG_START)

- **await completion**
  - EE_CognitivTrainingFailed
  - EE_CognitivTrainingSucceeded

- **accept training**
  - EE_CognitivTrainingControl(userId, COG_ACCEPT)

- **reject training**
  - EE_CognitivTrainingControl(userId, COG_REJECT)

- **receive acknowledgement**
  - EE_CognitivTrainingCompleted
For a copy of the SDKLite
Visit our website at www.emotiv.com
Select Developers on the menu bar
Select Download SDKLite from the side bar

Thank you!
Emotiv SDK - EmoEngine

Game Process

EmoEngine (EDK.dll)

EmoState Buffer

EmoState and EmoEvent query handling

EEG and Gyro Post-Processing

Control Logic

Game Input Loop

Game AI

Game UI
Emotiv SDK – API Usage

Initialization

EE_EngineConnect()

EE_EngineRemoteConnect()

Event Polling

EE_EngineGetNextEvent(EmoEngineEventHandle hEvent)
Detection Tuning

EE_ExpressivSetThreshold(…)

EE_CognitivSetCurrentLevel(…)

Detection Training

EE_CognitivSetTrainingAction(…)

EE_CognitivSetTrainingControl(…)
User Profile Management

- User profile stores per-user detection settings and training data
- Allows game to manage user profile data in manner that is ideal for that application or platform

```c
EE_GetUserProfile(unsigned int userId, EmoEngineEventHandle hProfile)
EE_GetUserProfileBytes(EmoEngineEventHandle hEvt, ...)
EE_SetUserProfile(unsigned int userId, ...)
```
Some Code Blocks ...

New EmoEngine Event

YES

Code to handle the EmoEngine Event

NO

Continue ...

Emotiv SDK - API Usage
• **EE_UserAdded**
  • Generated when Emotiv USB dongle is plugged into the computer. User ID is assigned at this time

• **EE_UserRemoved**

• **EE_EmoStateUpdated**
  • A detection has updated the user’s EmoState
  • Call EE_EmoEngineEventGetEmoState to retrieve EmoState handle
- Getter functions to access detection results
- Detection results can be binary (0/1) or continuous (0..1)

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<tr>
<td>Clenched teeth / grimace</td>
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<td>Eyebrow movement</td>
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<td>Excitement / Calmness</td>
<td>Continuous scale (101 increments, from most calm at 0.00 to most excited at 1.00)</td>
</tr>
<tr>
<td>Engagement (Focus)</td>
<td>Continuous (101 increments, from 0.00 to 1.00)</td>
</tr>
<tr>
<td>Frustration (coming soon)</td>
<td>Continuous (101 increments, from 0.00 to 1.00)</td>
</tr>
<tr>
<td>Cognitiv Actions 1-4</td>
<td>Continuous (101 increments, from 0.00 to 1.00)</td>
</tr>
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</table>
EE_CognitivEvent
  • Informs application of the status of Cognitiv training

EE_CognitivTrainingStarted

EE_CognitivTrainingSucceeded

EE_CognitivTrainingFailed

EE_ExpressivEvent
Demonstrate, tune, train and test detections

Emotiv SDK – Control Panel
• EmoEngine proxy: Use EE_EngineRemoteConnect to connect EDK.dll to Emotiv Control Panel
• Allows developers to start game integration and testing without having to build complete UI and game logic to support training, profile mgmt, detection tuning
Emotiv SDK - Composer

- EmoEngine and Headset emulator
- Generates EmoEngine events
- Responds to training and profile mgmt requests
- An utility that maps detection results to keystroke sequences
- EmoEngine detections can be used with existing games/application