

What is the Ultimate User Interface?

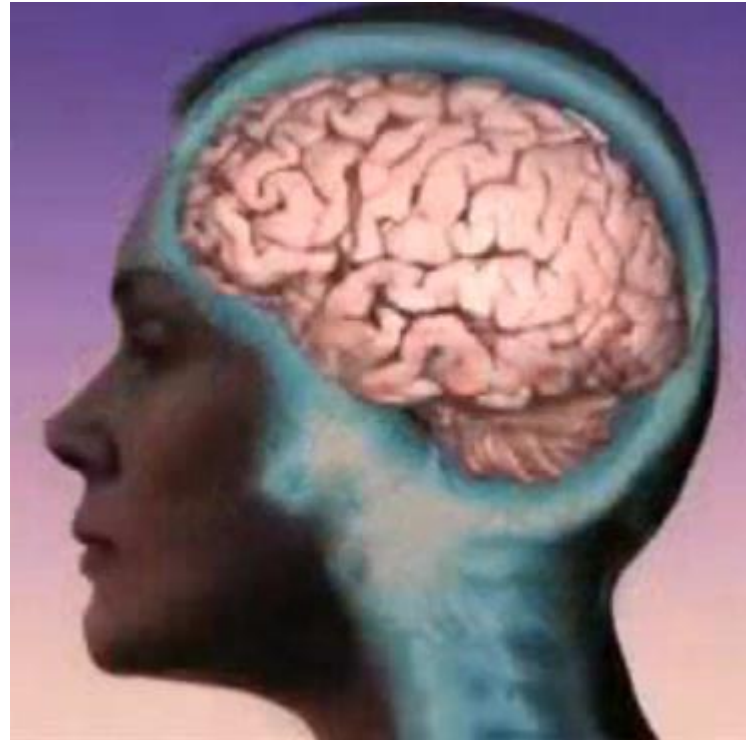
Learning Goals

- Understand ...
 - The challenge of building user interfaces
 - How the user interface impacts what people can do
 - The concept of bandwidth between human and system
 - The basic input and output operations supported by UIs

The Ultimate User Interface?

Do what I think!

- Turn my ideas and thoughts into reality.



Atari Mindlink (intended for release in 1984, never released)

... and many more, e.g. recently NEURALINK

**OUR NEWEST BRAINCHILD...
THE ATARI MINDLINK SYSTEM**

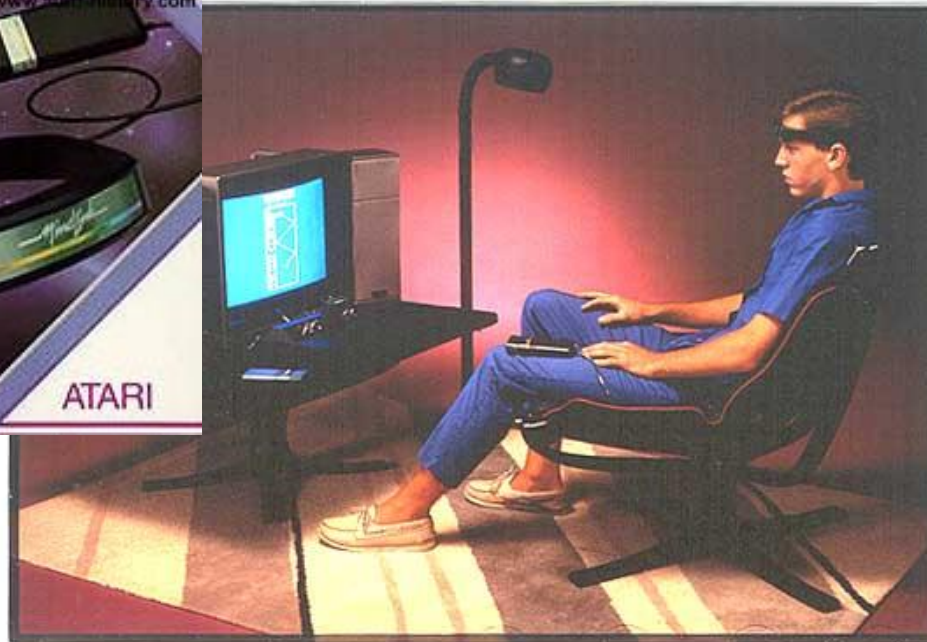
**AN ENTIRELY NEW AND EXCITING WAY
TO USE ATARI GAME SYSTEMS AND
COMPUTERS:**

- PLACED AROUND FOREHEAD, YOU "THINK" THE MOVEMENT OF OBJECTS ON SCREEN
- WORKS ON EMG TECHNOLOGY— (MEASURES MUSCLE ACTIVITY)
- TRANSMITS TO GAME CONSOLE VIA INFRARED REMOTE CONTROL—NO WIRES ATTACHED
- EXCITING, VERSATILE, EXPANDABLE
- OPENS UP ENTIRELY NEW AREAS TO VIDEO GAMING
- REWARDS RELAXATION AND CONCENTRATION
- INCREASES COMPUTER AND GAME SYSTEM INTENT TO PURCHASE
- INCLUDES INFRA-RED TRANSMITTER, RECEIVER, HEAD BAND AND ONE SOFTWARE CARTRIDGE

**"THE STATE OF THE ART
FOR THE STATE OF YOUR MIND!"**

The Atari Historical Society
<http://www.atari-history.com>

ATARI



<http://www.atarimuseum.com/videogames/consoles/2600/mindlink.html>

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Direct Brain-to-Game Interface Worries Scientists

By Emmet Cole 09.05.07

Your brain might be your next videogame controller.

That might sound pretty awesome, but the prospect of brain-controlled virtual joysticks has some scientists worried that games might end up controlling our brains.

Several makers of brain-computer interfaces, or BCIs—devices that facilitate operating a computer by thought alone—claim the technology is poised to jump from the medical sector into the consumer gaming world in 2008.

Companies including Emotiv Systems and NeuroSky say they've released BCI-based software-development kits. Gaming companies may release BCI games next year, but many scientists worry that users' brains might be subject to negative effects.

For example, the devices sometimes force users to slow down their brain waves. Afterward, users have reported trouble focusing their attention.

"Imagine that somebody uses a game with slow



NeuroSky's headset technology is being used in tandem with a software development kit to create BCI-based games. The first titles are expected to hit store shelves in 2008.

What is the Challenge in Making a UI?

... to support the user to turn ideas into reality!

- You want to tell your friends when and where to meet for dinner.
 - How can you communicate it to them remotely?
- You know there a document that describes how to repair your bike.
 - How can you find this document and get access to it?
- You have an idea for a story.
 - How to get from your idea to a book others can read?
 - How to make a movie that others see it?
- You imagine some musical tune.
 - How to capture it an make it into music others can listen to?
- You plan your new dream house.
 - How to create a 3D model that you can discuss with your friends?

What is the Challenge in Making a UI?

... to support the user to turn ideas into reality!

- You want to tell your friends when
 - How can you communicate it to them?
- You know there is a document that contains an idea
 - How can you find this document?
- You have an idea for a story



```
Program-working2.cs
c:\Users\albre> Dropbox > 0_todo > ConsoleApplication3 > ConsoleApplication3 > Program-working2.cs
215
216 static void analyseImgFiles()
217 {
218     string newFileNameKey;
219
220     for (int i = 0; i < completeFileList.Count; i++) // Loop through List with for
221     {
222         //Console.WriteLine(completeFileList[i]);
223         //StructuredFileList.Add("Nr:" + i, completeFileList[i]);
224
225         if ((i % 10) == 1) Console.WriteLine(".");
226         if ((i % 100) == 1) Console.WriteLine("{0:F2}%", 100.0 * i / completeFileList.Count);
227
228         newFileNameKey = CaptureDate(completeFileList[i]);
229
230         try
231         {
232             StructuredFileList.Add(newFileNameKey, completeFileList[i]);
233         }
234         catch
235         {
236             //Console.WriteLine("adding is a problem - " + completeFileList[i]);
237         }
238     }
}
```

discuss with your friends?

What can UIs do?

Imagine

Everything a **professional**

- Typesetter
- Photographer
- Publisher
- Filmmaker
- ...
- Programmer

can do today, could be done **by anyone.**

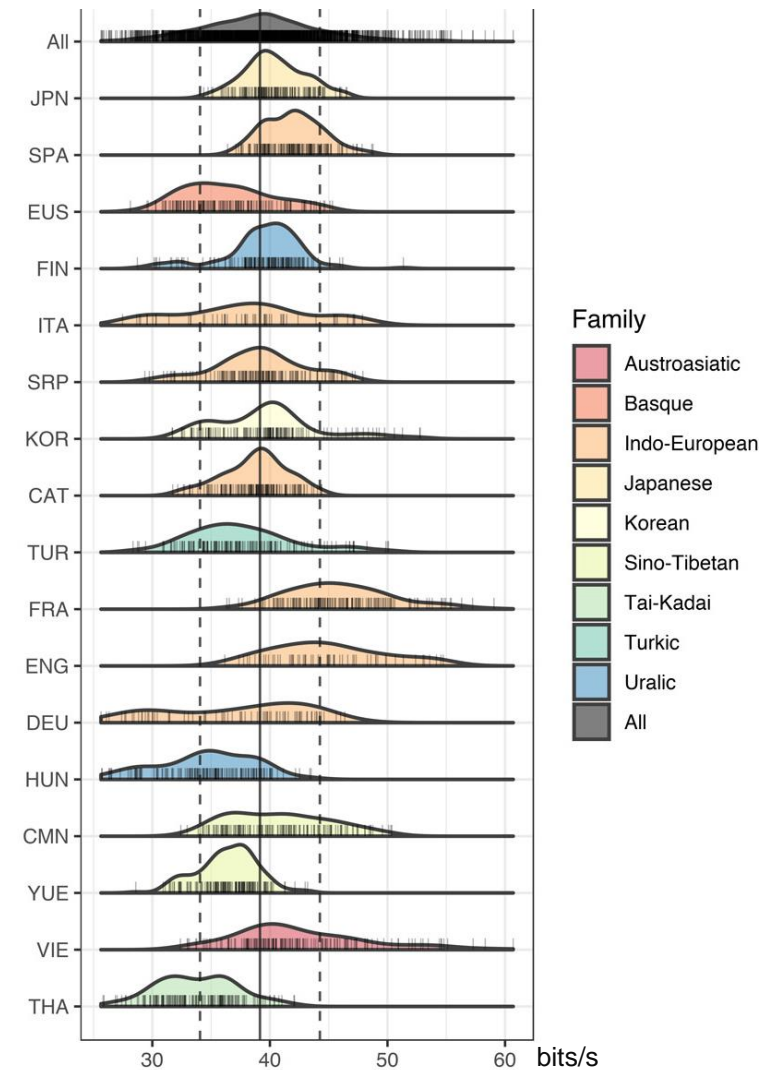
What is the User Interface?

The solution space

- What technologies are available to create UIs?
 - Hardware
 - Software
 - Systems
- How can users and interactive systems communicate?
 - Input (user to computer)
 - Output (computer to user)
- What is the time scale of interaction?
 - Immediate “real-time” interaction
 - Batch (offline) interaction

Thinking about Bandwidth of a UI

- Communication bandwidth in bits/second
- Human output bandwidth?
 - Speech: ~ 39 bits/second
 - Writing: ~ 200 characters/minute ~ 3 characters/second < 24 bits/s
 - Pointing
 - Thinking?
- Human input bandwidth?
 - Seeing < 6Mbit/s (conscious visual perception may be as low as 100bits/s)
 - Listening / hearing
 - Feeling / smell / taste
- Bandwidth is hard to tell!
 - 4K TV has 8,000,000 pixels x 3 bit x 100 Hz ~ 20 Gbit/s
 - Low bandwidth for information intake (e.g. reading about 5 words/second)
 - But we see/hear if things are wrong (e.g. music, movie, ...)
- Your brain is a limiting factor!



Coupé, C., Oh, Y. M., Dediu, D., & Pellegrino, F. (2019). Different languages, similar encoding efficiency: Comparable information rates across the human communicative niche. *Science Advances*, 5(9), eaaw2594.

Mini-Exercise: 1D Pointing

Setting: Museum exhibition

- Visualization of rainforest vegetation
- User group: kids age 4-8
- Interaction to look at vegetation at the selected height
- Given: image of 1,000 pixel wide and 12,000 pixel high (12,000 pixel represent 24 meters)
- Task: create an interface
 - Lets users select at what height the want to look
 - That is engaging
 - That does not require computer knowledge



Example: Computer Rope Interface



Winslow Burleson and Ted Selker. 2003. Canopy climb: a rope interface. In *ACM SIGGRAPH 2003 Sketches & Applications (SIGGRAPH '03)*. ACM, New York, NY, USA, 1-1. DOI=10.1145/965400.965549 <http://doi.acm.org/10.1145/965400.965549>

Design and Implementation options for UI

The design space?

- For **standard applications** on standard devices (desktop, mobile)
 - Based on a **software implantation** (typically using frameworks)
 - Understanding the differences in systems
 - Recommending a hardware setup
 - Best experience for potential users
 - Defining a **minimal set of requirements** (e.g. screen resolution, input device)
- For specific **custom made** products and applications
 - **Software and hardware**
 - Understanding options that are available
 - Innovative embedded user interfaces (devices, machines, cars, ...)
 - Creating a different and **unique experience** (e.g. for exhibition, trade fare, museum, ...)

Basic Input Operations

The design space?

Text Input

- Continuous
 - Keyboard Handwriting
 - Spoken
- Block
 - Scan/digital camera and OCR

Pointing & Selection

- Degree of Freedom (1, 2, 3, 6, DOF)
- Isotonic vs. Isometric
- Transfer function
- Precision
- Feedback

Direct Mapped Controls

- Hard wired buttons/controls
 - On/off switch, Volume slider
 - Physical controls that can be mapped
 - Function key on keyboard
- Industrial applications

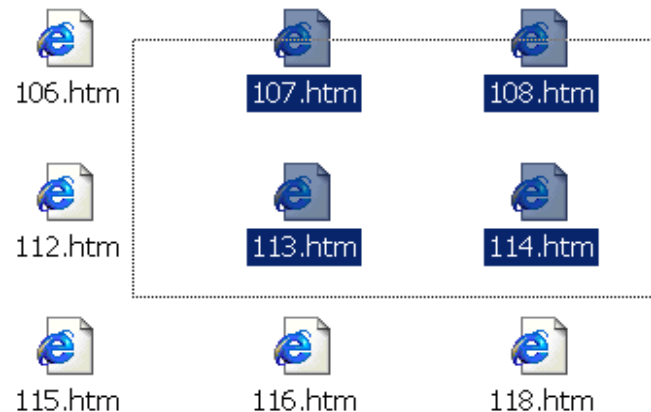
Media Capture

- Media type
 - Audio
 - Images
 - Video
- Quality/Resolution

Complex Input Operations

The design space?

- Examples of tasks
 - Filling a form = pointing, selection, and text input
 - Annotation in photos = image capture, pointing, and text input
 - Moving a group of files = pointing and selection
- Examples of operations
 - Selection of objects
 - Grouping of objects
 - Moving of objects
 - Navigation in space



Basic Output Operations

The design space?

Visual Output

- Show static
 - Text
 - Images
 - Graphics
- Animates
 - Text
 - Graphics
 - Video
- Technologies
 - Paper
 - Objects
 - Displays

Audio Output

- Earcons
- Auditory icons
- Synthetic sounds
- Spoken text (natural / synthetic)
- Music
- Technologies
 - Speakers
 - 1D/2D/3D

Tactile

- Shapes
- Forces
- Technologies
 - Objects
 - Active force feedback

Further senses

- Smell
- Taste
- Temperature
- ...



Did you understand this block?

Can you answer these questions?

- How does the user interface change people's capabilities?
- Name areas where it is still hard to translate an idea into a digital artifact.
- Why is it hard to assess the bandwidth of the communication between the human and the system?
- What are basic input operations commonly used?
- What typical audio output do we consider in UIs?

Reference

- Coupé, C., Oh, Y. M., Dediu, D., & Pellegrino, F. (2019). Different languages, similar encoding efficiency: Comparable information rates across the human communicative niche. *Science Advances*, 5(9), eaaw2594.
- Winslow Burleson and Ted Selker. 2003. Canopy climb: a rope interface. In *ACM SIGGRAPH 2003 Sketches & Applications (SIGGRAPH '03)*. ACM, New York, NY, USA, 1-1. DOI=10.1145/965400.965549 <http://doi.acm.org/10.1145/965400.965549>
- http://www.wired.com/medtech/health/news/2007/09/bci_games
- <http://www.atarimuseum.com/videogames/consoles/2600/mindlink.html>

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