



## > Replacing the computer mouse



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## 0) Foreword



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Hands-free paintings!

## 0) Foreword



**Video** <http://youtu.be/flcGJCUAMJg>

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The first mouse prototype was created in 1963 by Douglas Engelbart at the Stanford Research Institute... almost 50-year-old!



## 1. Introduction

2. Moving the mouse cursor

3. Emulating the mouse click

4. Getting rid of the keyboard as well

5. Conclusion & perspectives

## 1) Introduction



### Important drawbacks

- Loss of productivity: constantly switching between the mouse and the keyboard.
- Health issues: RSI (repetitive stress injuries).



# 1) Introduction



Adhesive Capsulitis (Frozen Shoulder), Bursitis, Carpal Tunnel Syndrome, Cramp of the Hand (Writers' Cramp), Cubital Tunnel Syndrome, De Quervain's Syndrome, Dupuytren's Contracture, Epicondylitis (tennis / golfer's elbow), Ganglion Cyst, Peritendinitis, Rotator Cuff Syndrome, Tendinitis, Tenosynovitis, Trigger Finger / Thumb, Vibration-induced White Finger...

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### **RSI!**

- 15-25% of all computer users worldwide are estimated to have RSI.
- A survey of 500 software professionals at Hyderabad in 2000 revealed that over 50% had symptoms of established RSI.
- Billions of dollars are spent worldwide annually as a consequence of RSI

## 1) Introduction



**Chronic pain may cost U.S...**

**\$635 billion a year !!**

**Source:**

**<http://medicalxpress.com/news/2012-09-chronic-pain-billion-year.html>**

## 1) Introduction



### Important drawbacks

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## 1) Introduction



### Important drawbacks

- Loss of productivity: constantly switching between the mouse and the keyboard.
- Health issues: RSI (repetitive stress injuries).
- Unnatural user interface.

# 1) Introduction



We do not aim at replacing the mouse as a pointing device but simply the mouse as a piece of hardware.

We therefore stay in the mouse paradigm and focus on the hardware interface.

The computer mouse allows two kinds of action:

- moving the mouse cursor,
- sending mouse clicks.

## 1) AI > definitions



Hands-free mice are numerous:

- **Camera based head tracking systems**: SmartNav, Tracker Pro, FreeTrack, HeadMouse Extreme and HeadMaster,
- **Mouth-operated joystick types**: the TetraMouse, the QuadJoy, the Jouse2, the IntegraMouse,
- **Footmice**: BiLiPro, Flip Flop Mouse, Footime Foot ControlledMouse,
- **Brain-computer interaction**: the Emotiv EPOC neuroheadset, the NeuroSky MindSet/MindWave,
- **Eye tracking**.

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## 2) Moving the mouse cursor



**Footmice** might cause stress on the feet or the legs and takes a while to get precise with them. Still worth the try as it is inexpensive and one can get impressively accurate with one's feet.



Footime® Foot Mouse (150 USD)

## 2) Moving the mouse cursor



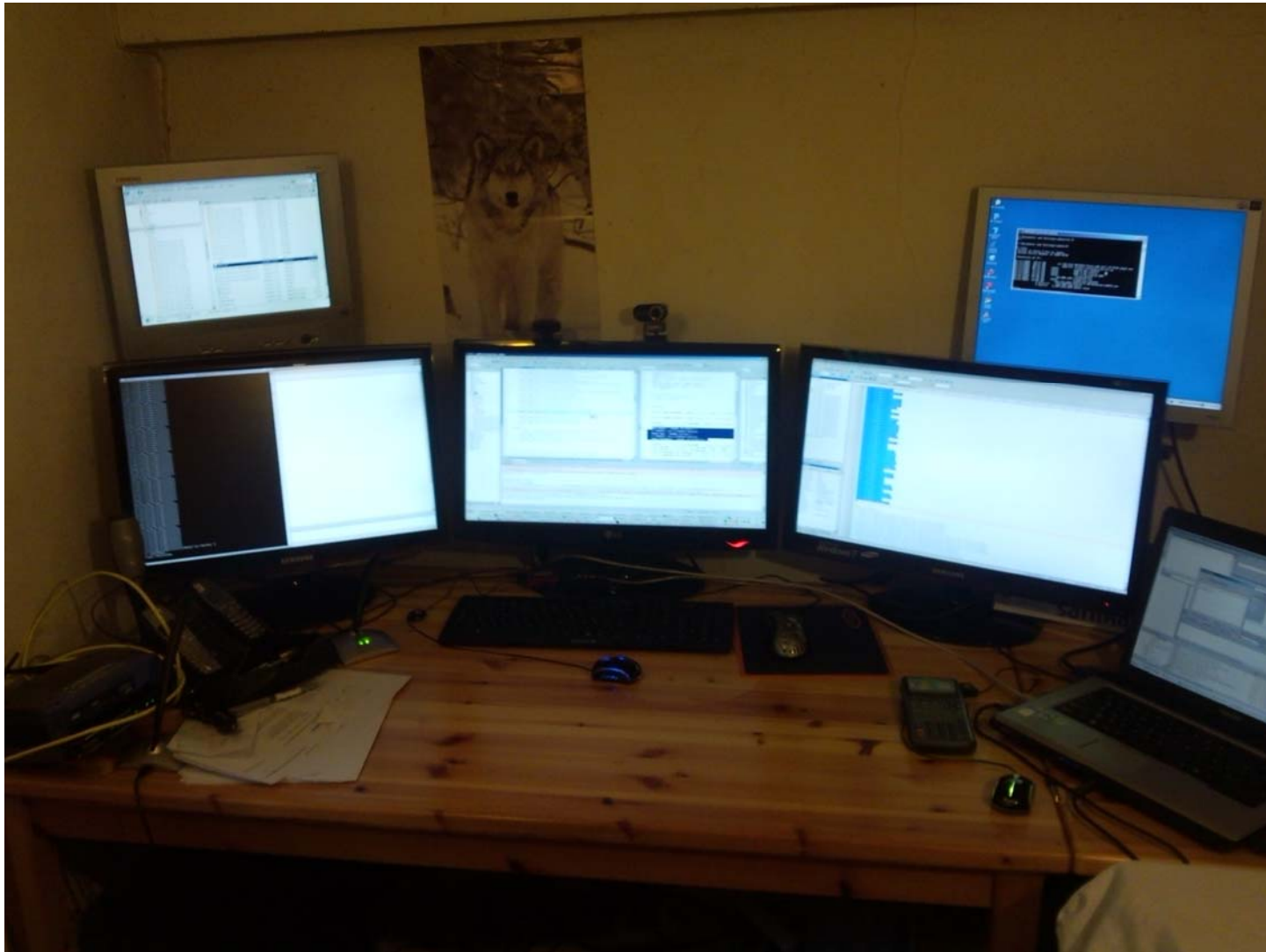
**Eye tracking:** either pretty bad or expensive (5,000 USD), and don't support multiscreen configuration.



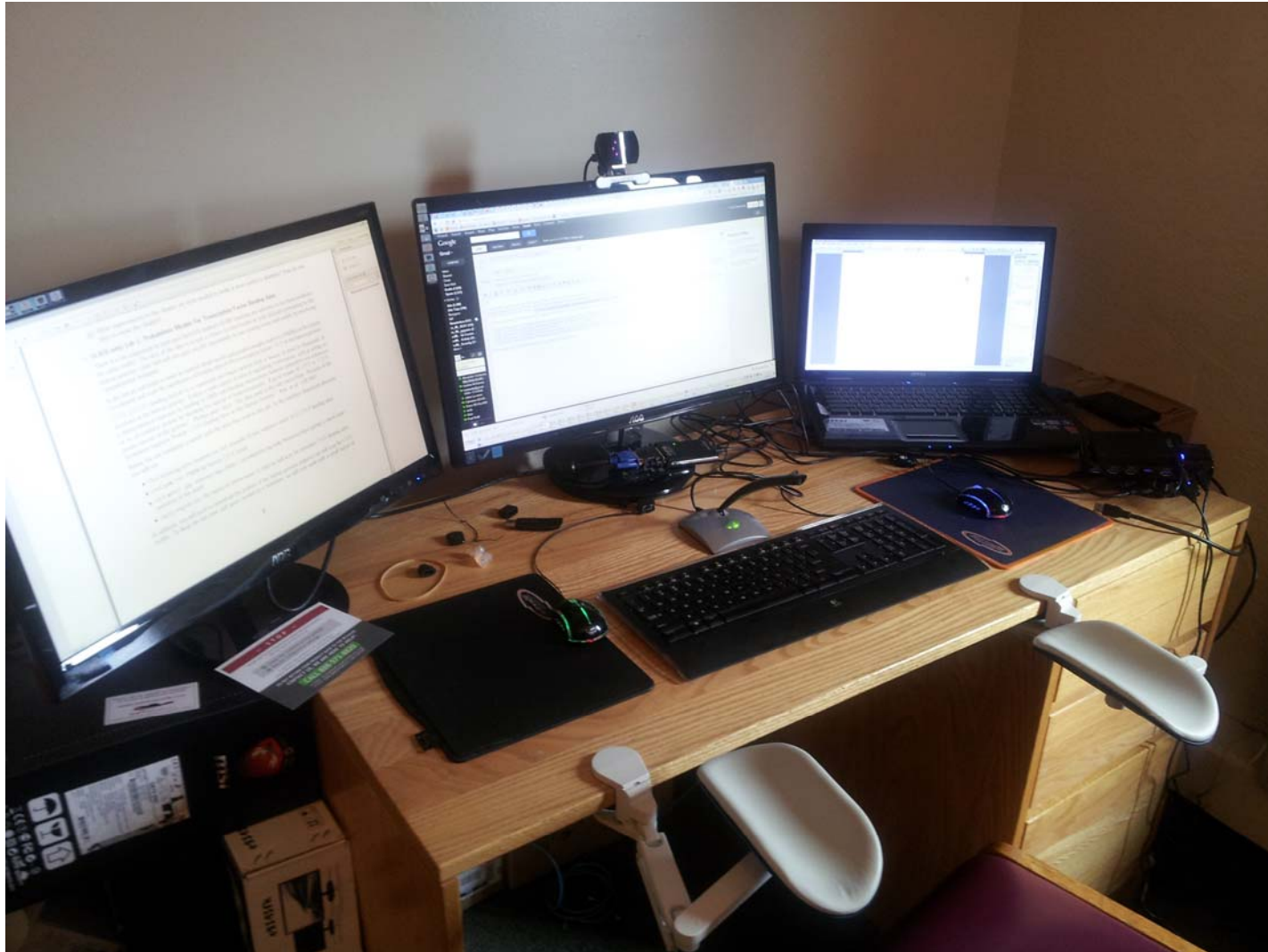
EyeTech (> 4,500 USD)

**BUT** this is might be the future: basic webcam + open source software (e.g. ITU GazeGroup).

## 2) Moving the mouse cursor



## 2) Moving the mouse cursor



## 2) Moving the mouse cursor



Among the **camera based head tracking systems**, SmartNav is the cheapest (300-400 USD). As its precision is as good as the one of a computer mouse, there is no need to invest into the Tracker Pro, FreeTrack, HeadMouse Extreme or HeadMaster (over 1,000 USD).

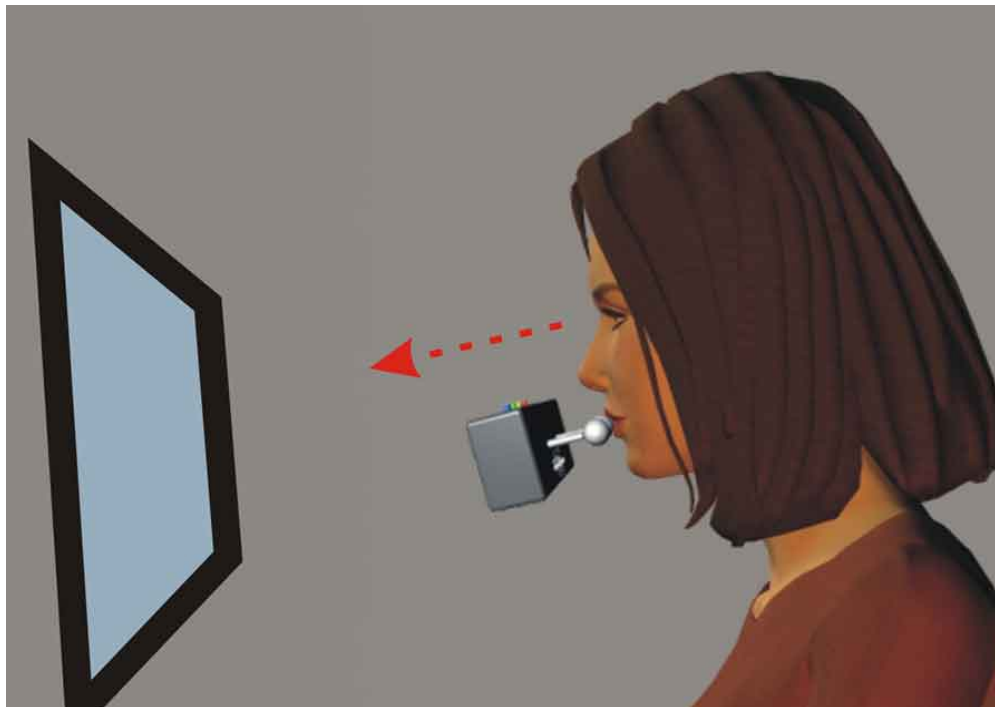


## 2) Moving the mouse cursor



The **mouse-operated joysticks** are pretty intrusive since one has to put them in the mouth, but this solution is interesting for people who can't move their head or have severe pain in the neck.

The TetraMouse is the cheapest by far.



## 2) Moving the mouse cursor



**Brain computer interaction** are so far mostly useless to move the mouse cursor.

Note that the **Emotiv EPOC neuroheadset** contains a gyroscope (=device for measuring or maintaining orientation), thanks to which the user can move the mouse cursor as precisely as a computer mouse.



Emotiv EPOC neuroheadset (300 USD)

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### 3) Emulating the mouse click



**Hotkeys:** re-map keys from the keyboard and assign them to emulate the left, right and middle mouse buttons.



### 3) Emulating the mouse click



**Dwell clicking software:** when the cursor stops moving for a pre-determined amount of time (usually around 1 second), the dwell clicking software will initiate a mouse click. The user can have the software send left clicks, right clicks or double clicks.



SmartNav's dwell clicking software (free)

### 3) Emulating the mouse click



**Footswitches:** allow the user to send mouse clicks by pushing a pedal.



**!! Beware of repetitive strain injuries at the ankles.**

### 3) Emulating the mouse click



**Sip-and-puff:** send signals to a device using air pressure by "sipping" (inhaling) or "puffing" (exhaling) on a straw, tube or "wand."



### 3) Emulating the mouse click



**Speech recognition:** set a few voice commands that the user can say to emulate mouse clicks.



### 3) Emulating the mouse click



**Facial expression recognition:** maps facial expressions such as eye blink, wink or smile to mouse clicks.



EyeTech (> 4,500 USD)

### 3) Emulating the mouse click



**Facial expression recognition:** maps facial expressions such as eye blink, wink or smile to mouse clicks.



NeuroSky MindWave (100 USD)



Emotiv EPOC neuroheadset (300 USD)

### 3) Emulating the mouse click



**Brain-computer interaction:** maps concepts to mouse clicks. When the user thinks of one concept, a mouse click is sent.



NeuroSky MindWave (100 USD)



Emotiv EPOC neuroheadset (300 USD)



### 3) Emulating the mouse click

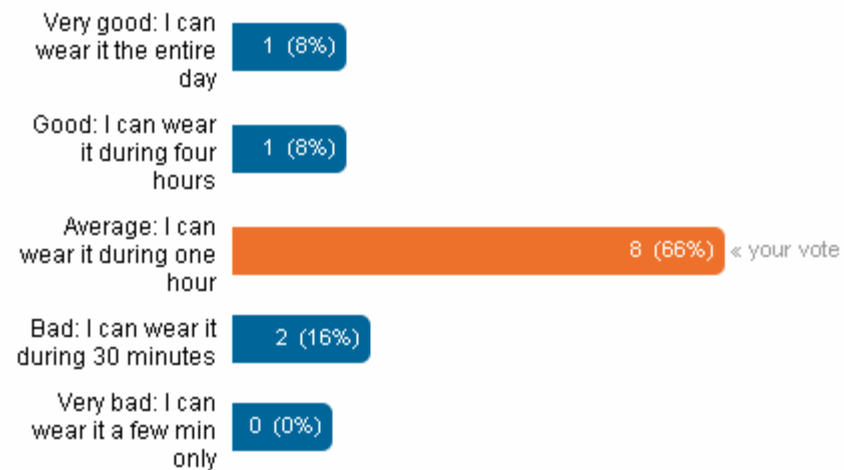


#### Headset comfortability



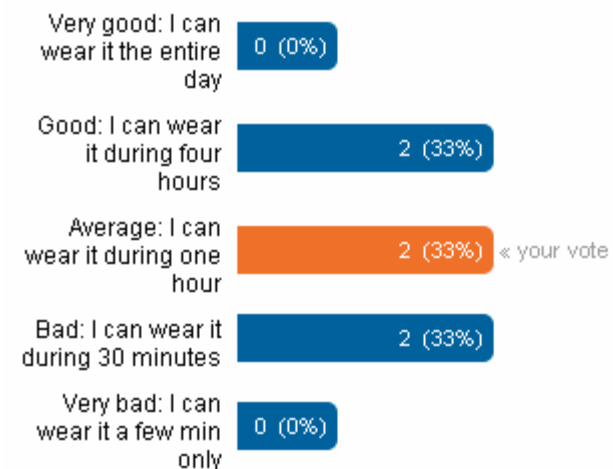
How comfortable is the NeuroSky MindWave?

posted 1 month ago • 12 votes



How comfortable is the Emotiv EPOC neuroheadset?

posted 20 days ago • 6 votes



### 3) Emulating the mouse click



#### Synopsis

Solution	Pros	Cons
Hotkeys	Free, easy to use, no latency	Requires to use the keyboard, not so good for RSI (much better than mouse clicks though)
Dwell clicking	Free, easy to use, no latency, hands-free	Requires to wait ~1s before click is sent, takes some time (~1s) to switch between mouse click type
Speech recognition	Easy to use, already integrated within Dragon NaturallySpeaking	High latency, put some strain on the voice, noisy
Facial expression	Hands-free	Quite expensive (100-300USD), detection is not 100% accurate, headsets are not comfortable
Brain-computer interaction	Hands-free	Latency, quite expensive (100-300USD), not accurate enough to emulate mouse clicks, headsets are not comfortable

### 3) Emulating the mouse click



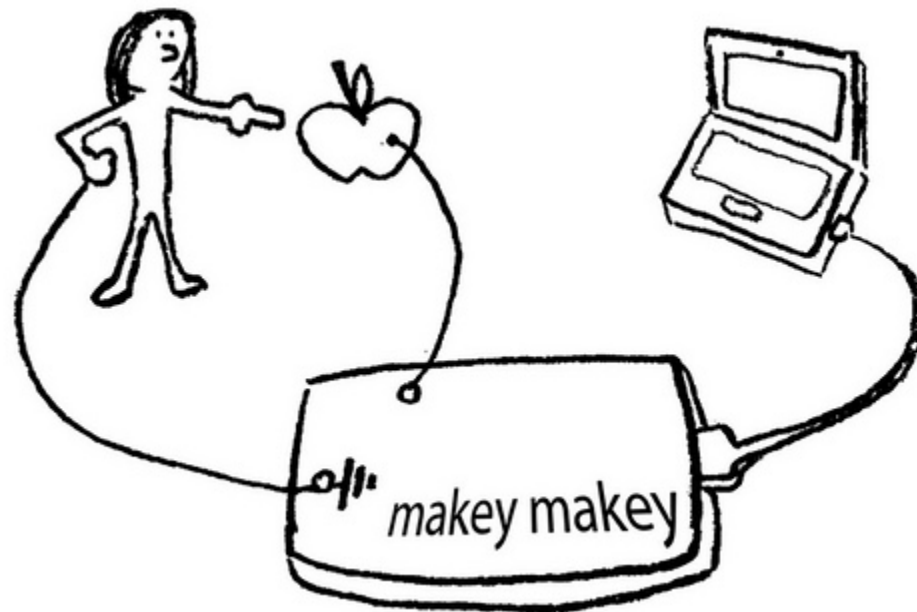
**My current configuration:**

Dwell clicking + hotkeys + speech recognition

### 3) Emulating the mouse click



Next test (hopefully in a few days): MaKey MaKey!



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## 4) Getting rid of the keyboard as well



## 4) Getting rid of the keyboard as well



## 4) Getting rid of the keyboard as well



The average rate for transcription is **33 words per minute**, and 19 words per minute for composition.

An average professional typist types usually in speeds of **50 to 80 words per minute**.

More statistics on [http://en.wikipedia.org/wiki/Words\\_per\\_minute](http://en.wikipedia.org/wiki/Words_per_minute)



## 4) Getting rid of the keyboard as well



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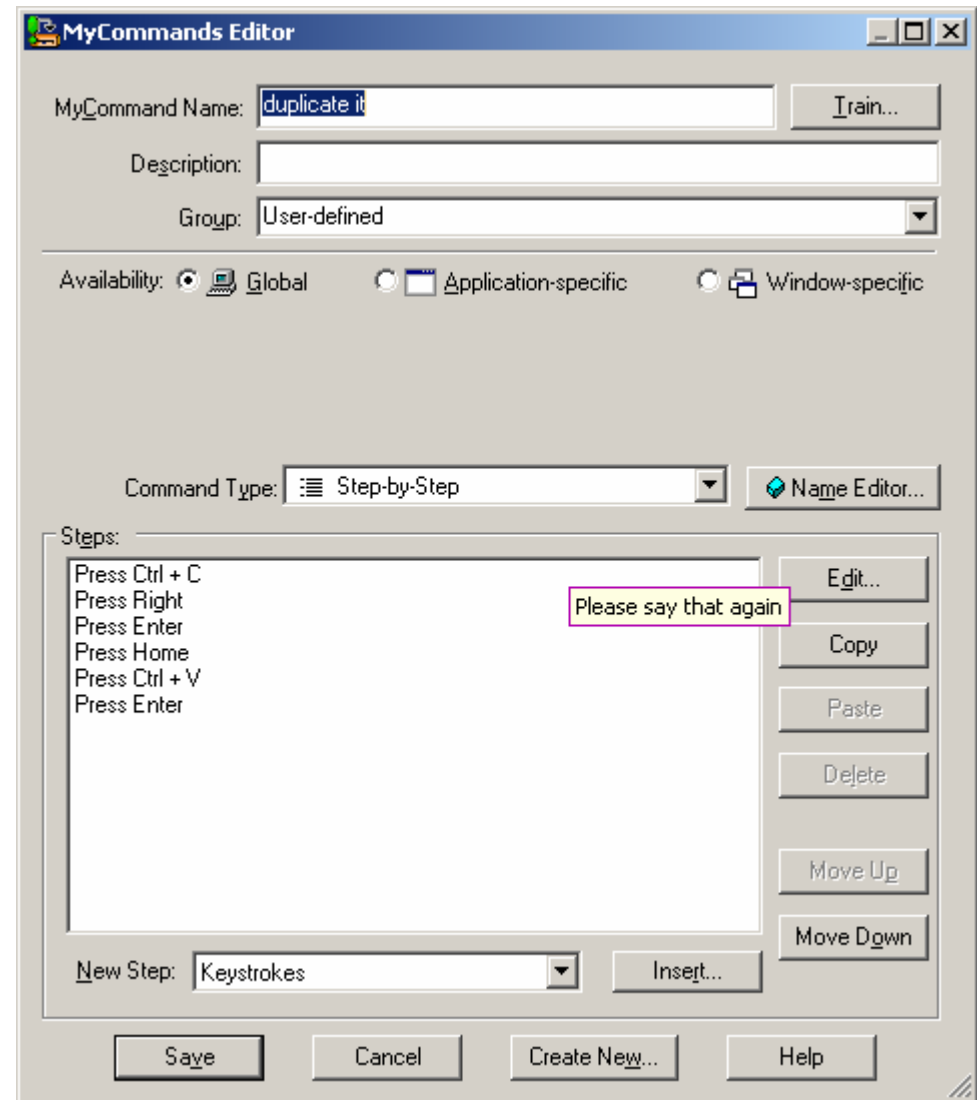
Using speech recognition, one can easily achieve **over 100 words per minute** with more than 95% accuracy.

## 4) Getting rid of the keyboard as well



Many **voice commands** are available, such as any shortcut (e.g. copy paste), typing a predefined text, switching windows, browsing the web, sending e-mail and launching programs.

Custom commands can also be easily defined:



## 4) Getting rid of the keyboard as well



## 4) Getting rid of the keyboard as well



Work in progress!

## 4) Getting rid of the keyboard as well



### Subvocal recognition



## 4) Getting rid of the keyboard as well



### Throat microphones



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## 5) Conclusion & perspectives

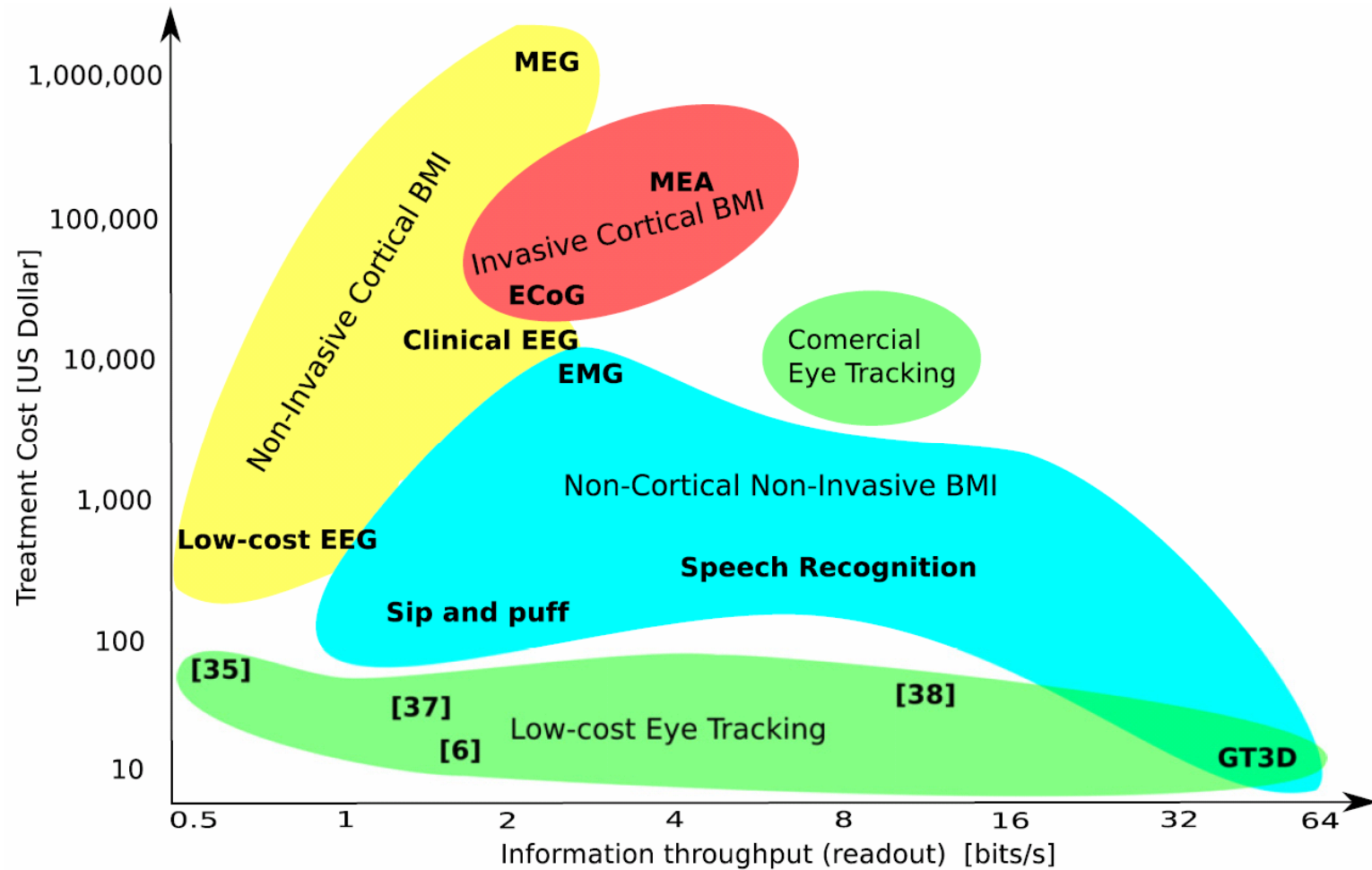


### Conclusion:

- **SmartNAV** + Dwell clicking + hotkeys + speech recognition
  - Speech recognition
- 
- Replace 95% of the use of the mouse and the keyboard.
  - More efficient, more comfortable.



## 5) Conclusion & perspectives



## 5) Conclusion & perspectives



### Conclusion:

### Natural user interfaces



## 5) Conclusion & perspectives



### Conclusion:

### Natural user interfaces



**Eye tracking**  
**Brain computer interfaces**

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