The Camera Mouse – A Camera-based Interface for People with Severe Motion Impairments

Margrit Betke
Boston University
Users in Need

Millions of people with
- Severe cerebral palsy
- Traumatic brain injury
- Stroke
- Multiple sclerosis, muscular dystrophy
- ALS (Lou Gehrig’s)

cannot communicate with traditional means:
- Often nonverbal
- Limited voluntary motion

Lack of communication ability ≠ lack of active minds!

Communication technology
often not available or too expensive, inefficient, difficult, etc.

Intelligent assistive interfaces can greatly improve the lives of people with severe paralysis
My Team
Traditional Approaches

Binary Switch
(blue button)

- Touch Switches
  - Hit plate
  - Wobble stick
  - Grip handle
  - Pinch
  - Pull string

- Photocell Switches
- Sip or Puff Switches
- Voice activated Switches
Traditional Approaches

EagleEyes by J. Gips at Boston College

Severe paralysis may leave the eyes as the only muscles that a person can control

Gaze direction is detected through electro-oculography
Traditional Approaches

Active Infrared Lighting for Gaze Detection

Non-commercial custom-made hardware
(e.g., IBM’s Blue Eyes)

Relatively expensive commercial hardware
(e.g., Applied Science Laboratories)

- Calibration procedure?
- Long term effect of infrared light on eyes?
- Costs?
Gestures of MS/CP Patients
The Camera Mouse
The Camera Mouse

- Camera-based tracking of body to enable control of a mouse pointer

- Has been commercialized and sold to individuals, schools, and hospitals in the US and Europe

User with ALS
# Camera Mouse Users (2001)

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Condition</th>
<th>Continuing to Use?</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>M</td>
<td>CP</td>
<td>Y</td>
<td>Obtaining a system for home.</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>CP</td>
<td>Y</td>
<td>First user with home system.</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>CP</td>
<td>Y</td>
<td>Spelled name. Obtaining a home system.</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>CP</td>
<td>Y</td>
<td>Spells naughty words and laughs.</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>CP</td>
<td>Y</td>
<td>Obtaining a home system.</td>
</tr>
<tr>
<td>14</td>
<td>M</td>
<td>CP</td>
<td>Y</td>
<td>Spells words. Obtaining a home system.</td>
</tr>
<tr>
<td>15</td>
<td>M</td>
<td>CP</td>
<td>N</td>
<td>Close, but could not control reliably.</td>
</tr>
<tr>
<td>19</td>
<td>M</td>
<td>CP</td>
<td>N</td>
<td>Does not have sufficient muscle control.</td>
</tr>
<tr>
<td>23</td>
<td>M</td>
<td>TBI</td>
<td>N</td>
<td>Does not have sufficient muscle control.</td>
</tr>
<tr>
<td>31</td>
<td>M</td>
<td>TBI</td>
<td>Y</td>
<td>Spelled &quot;TAKE OFF DAD&quot;</td>
</tr>
<tr>
<td>37</td>
<td>M</td>
<td>CP</td>
<td>Y</td>
<td>Spelled &quot;MERRY CHRISTMAS&quot;</td>
</tr>
<tr>
<td>58</td>
<td>M</td>
<td>CP</td>
<td>Y</td>
<td>Spells, explores internet on home system.</td>
</tr>
</tbody>
</table>
Impact

- Numerous camera mouse users with cerebral palsy, multiple sclerosis, ALS, traumatic brain injuries
- Camera Mouse currently used in:
  - Schools
  - Hospitals
  - Nursing Homes
  - At Home
- 26 schools in Northern Ireland obtained the Camera Mouse in 2003
- Free download from www.cameramouse.org since April 2007
- Several millions of downloads

Free download from www.cameramouse.org since April 2007

Several millions of downloads
I'm so grateful to you. Because I'm a MS(Multiple Sclerosis) patient since 20 years. I can't move my finger. However I'm in internet for 10 hours at this time. Thank you very much for everything.

Sincerely

Dr. Mesut
Thank-you email from a user

Sent: Thursday, 4 September 2008 16:53:58 +1000

G’day,

[...] a great big thank you from all the way over here in Australia. I have found your fantastic program while looking for an alternative to the expensive trakir and other type head tracking software. [...] I already have a degree of lack of movement in my right arm, shoulder, through to my elbow which also incorporates my ability to grip tightly with my right hand. I am right handed so this is a real pain [...] as well as my condition giving me great pain in movement. I do not take analgesics, I try and keep surfing and swimming and try to keep moving the parts as much as possible. What I am finding is that the program works very well, I am using my daughter’s ASUS lap top with built in camera, I can control the cursor OK and feel with more practice will become very proficient. I thank you and your team for your outstanding work in this area.

Best Regards to you all Over there.

L. P.
Date: Fri, 9 Jan 2009 14:29:42 +1100 (AUS Eastern Daylight Time)
From: "Jacqui Rogers" <jacquelinenerogers@optusnet.com.au>
To: <gips@bc.edu>
Subject: thank you

Hi Professor,

My name is Jacqui and I have severe Athetiod Cerebral Palsy. For about sixteen years my only form of computer access was with the scanning program E Z Keys with a headswitch. Now thanks to you I’m using Camera Mouse with the onscreen keyboard program Grid Keys. Having an alternative to the headswitch has really changed my life as I don’t suffer from fatigue due to typing as much now.

I can't express how grateful I am to you for developing Camera Mouse. Thankyou so much!!! I hope you don't mind but I've put a link to your site on www.jacquirogers.id.au

Kindest Regards,
Jacqui Rogers.

http://www.jacquirogers.com.au

http://www.jacquirogers.id.au ; www.gigsnreviews.com (music blog); http://thinkingpoet.blogspot.com/ (poetry blog)
If you have time, please click on ads on my blogs. Thank you!
Thank-you email from a user

Hi Professor,

My name is Jacqui. I have quadriplegia and use an E-Z key. I type with one hand. I am often dependant on others for life.

It’s immoral you say, but how would you cope living like this; being non-verbal, being dependant on others for life? How would you cope? Would you cope?

Jacqui’s poetry on stem cell research:

---

It’s immoral you say,
But how would you cope living like this;
Being non-verbal,
Being dependant on others for life?
How would you cope?
Would you cope?

---

http://www.jacquirogers.com.au

---

By Jacqui Rogers

---

Jacqui Rogers

---

Thank you.
Hi Dr. Betke,

I am reaching out because you are the only other listed collaborator on the Camera Mouse website. It appears that Dr. Gips has unfortunately passed away in 2018, and there aren’t any updates on the Camera Mouse website to indicate if further development of Camera Mouse is in progress.

It looks like that while Camera Mouse is free to download and use, it is not open source -- is that right? I am XXX at Brown University, and I was interested in improving Camera Mouse for personal use (my father has advanced Multiple Sclerosis and can no longer use his hands or arms). While there are some commercial head trackers available, the cost is quite prohibitive.

Do you have any information about what languages/software were used to create Camera Mouse, or if the backend code is available for non-commercial tinkering?

Thank you in advance for your help!
Tracked Features
Camera Mouse Demo on Eagle Aliens

Free download at www.cameramouse.org