Privacy user interfaces for eye-tracking

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How eye-tracking works

1. The eye tracker incorporates near-infrared microprojectors, optical sensors and image processing.

2. Microprojectors create reflection patterns on the eyes.

3. Image sensors register the image of the user, the user's eyes, and the projection patterns, in real time.

4. Image processing is used to find features of the user, the eyes and projection patterns.

5. Mathematical models are used to exactly calculate the eyes' position and the gaze point.

Tobii
Time-stamped gaze data plus semantics
Opportunities and applications

One-off research tasks
- User interface testing (online, physical)
- Package design
- Store planning, shelf layout

Niche applications
- Various medical diagnosis
- Sports performance support
- Security, law enforcement

Mainstream, continuous
- Attention monitoring
- Relevance measurement
- Ad billing
- Drowsiness detection
- Input modality (for disabled, kiosks)

GM to launch cars that can pick up on distracted driving
Preparing to launch the world’s first mass-produced cars with eye- and head-tracking technology that can tell whether drivers are distracted

By Sally Davies, FT
Published: 17:00 September 1, 2014
Eye-tracking output data

Gaze data
- Gaze direction and point
- Combined with object of interest

Eye data
- Eye presence
- Eye position and movement
- Eyelid closure (blinks)
- Pupil size and dilation

Biometrics
- User re-identification
- Inferred: age, medical condition

Preferences and lifestyle

Eye movements to smoking-related pictures in smokers: relationship between attentional biases and implicit and explicit measures of stimulus valence
K Mogg, BP Bradley, M Field, J De Houwer - Addiction, 2003 - Wiley Online Library
... also operate in initial attentional shift mechanisms, as smokers preferentially directed their gaze towards smoking-related scenes, while non-smokers showed no bias. Although this evidence is not conclusive as the groups did not differ significantly on this eye movement index...
Regions of interest
Regions of interest: by gender

Chest: Men +37%

Ring: Women +27%

Figure 22: The gaze plot of a Brazilian woman after 5 seconds of viewing

Figure 23: The gaze plot of a Brazilian man after 5 seconds of viewing
Potential remedies

- Obstruction and destruction
- Meaningful browser APIs
- Meaningful notice to users
- Meaningful choice and control
- Policy and regulation

Semantic APIs

- Eye-triggered events: ongazeenter
- :seen pseudo-class, queryable
- Heatmaps: getUserMedia

Notice and choice

- Privacy consequences: explain collected and inferred data
- Status indicators (LED, icons)
- Hardware and software switches
Thank you.