Gaze Tracking

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Introduction and goals

- Introduce the human eye
- Compare gaze tracking methods
- Discuss quantifying gaze data
- Discuss the impact of gaze tracking on HCI
Visual resolution, perception and the human eye

- Human vision has a wide visual range of about 180 degrees
- Resolution of vision lessens further away from the center
Processing a scene

- Analyze scenes with ballistic eye movements called saccades
- Bottom-up processing / reflexive saccades
- Top-down processing / volitional saccades
Yarbus 1967

- Evidence of goal oriented perception

“The Unexpected Visitor” by Ilya Repin
- Ballistic eye movements are not exclusive to scene processing
- Fixations range from about 100 ms to about 500 ms
- Saccades take 20 - 40 ms
Eye tracking methods

- Pupil-tracking methods
  - Visible light
  - Infrared
- Retina-tracking methods
  - Electrooculography
  - Electroretinography *
Eye tracking with visible light

- Many people already have webcams
- Usually assisted by face tracking
  - Eye corners commonly used as reference points for gaze calculation
- Subject to noise and environment concerns
- Accuracy issues
Eye tracking with infrared

- Reduced noise compared to visible light sensors
- Accurate motion correction using corneal reflection
- Wavelength used is both safe for human eyes and invisible
Eye tracking with Electrooculography (EOG)

- Very accurate
- Can track eyes when closed
- Less invasive than other retinal tracking methods
- More expensive
Calibration of eye tracking devices

Display Coordinates

Gaze Tracker Coordinates
Quantifying gaze data

- Tracking the length of fixations in predefined regions
- Visualized with fixation heatmaps and saccade/fixation graphs
Analyzing gaze data (1/2)

- Many experiments suggest that people perceive moving scenes much more narrowly than static imagery.
- Consistently high level of attention given to faces.
Recent case studies show consistent responses in the viewing of the montage scene of the popular Pixar film “Up”.

Viewers consistently alternate proportion of fixation on Carl’s or Ellie’s face in the same locations throughout the scene.

Considered a high value case study for research on modulating image salience.
Learned vision

- Knowing additional information about a person allows more accurate prediction of their viewing patterns.
- Consider the image on the right from the perspective of both a fan of bullfighting and an animal rights activist.
Impact on HCI and usability testing

- Provides opportunity for novel user interfaces.
  - Accessibility controls.
  - Turn displays off when not in use.
- Useful for evaluating UI designs and testing methodologies.
Designing with gaze tracking data

- Choosing the layout of a web form.
Comparing UX testing methods

Think Aloud (TA)  Retrospective TA (RTA)
Questions?

Eye.

Eye, Eye.
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