### GazeVis: An Eye-Tracking Visualization Towards Predicting User Distraction

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# Introduction

- GazeVis is a visualization of eye-tracking data collected from an application called GazeReader (developed in another course).
- GazeReader's interface is able to track a user's gaze pattern, as well as self interruptions while users are participating in a reading activity.



# Motivation

- Reading tasks
  - Reading research papers for courses
  - Requires concentrated reading
  - Self-interruptions occur
- Self-interruptions
  - Switching applications (to a non-reading related activity)
  - Looking away

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|           |   |   | Gloria Mark <sup>1</sup> , Shan   | nsi T. Iqbal²,   | Mary Cze   | rwinski², Paul Jo  | hns <sup>2</sup>  |  |   |
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|           | ABSTRACT<br>While distractions using digital media have r<br>attention in HCI, understanding engagement in we<br>activities has here little explored We haved | ave received<br>in workplace  | is importan<br>people are<br>inform the<br>workplace  | nt because if we es<br>engaged and involv<br>design of tools and in<br>experience.   | an gain insight in<br>red in their work,<br>aterfaces to promot  | to when<br>this can<br>te a better   |   |  |   |
|           | and con<br>workers<br>states ch<br>engagem<br>and rote<br>boredom<br>doing rot<br>Mondays<br>Online a<br>states, så<br>day, and<br>how rhyt                   | tinually 1<br>for five d<br>ange with<br>ent and cl<br>work. Ov<br>in the wo<br>is highes<br>e work an<br>people<br>ctivities<br>towing di<br>before an<br>hms of att | orobed perspectives of 32<br>asys in situ to understand he<br>context. We present a framu-<br>allenge m work relate to fo-<br>erall, we find more focused<br>rkplace Focus peaks mid-af<br>it in early aftermoon. People<br>ad most stressed doing focu<br>are most bored but also re<br>are associated with differe<br>fiberent patterns at beginnin<br>d after a mid-day break. Oue<br>entional states are associated | information<br>w attentional<br>ework of how<br>use, boredom,<br>attention than<br>termoon while<br>are happiest<br>sed work. On<br>host focused.<br>at attentional<br>g and end of<br>study shows<br>with context | The dynam<br>states of inf<br>factors: the<br>interruption<br>online activ<br>Studies in<br>science ha<br>attention is<br>ignored on<br>workers m<br>multitask<br>fragmented<br>Under thes | ic nature of the work<br>formation workers to<br>task-at-hand, intera-<br>sk, and other contex<br>ities which constitut<br>the field of organ<br>two investigated ht<br>a the workplace, e<br>line activity. Howev<br>ostly engage in dig<br>frequently, digital<br>attention and chang<br>e premises, we fe | cplace can cause a<br>change depending<br>tions, their affect<br>tual conditions, a<br>e a large part of th<br>izational and ma<br>ww people alloc<br>g. [26], but hav<br>'er, given that in<br>ital activities and<br>work patterns c<br>es in engagement<br>el that it is imp | ttentional<br>on many<br>tive state,<br>s well as<br>ueir work.<br>agement<br>ate their<br>re mostly<br>formation<br>d tend to<br>an cause<br>i in work. |   |

In order to prevent this from happening, we need to understand when is a user likely to self-interrupt.

## Data Collection

- Fixations
  - Count, Duration
- Saccades
  - Duration, Length, Angle
- Tagged Interruption
  - Loss of focus of the Reader application

2017-11-12T01:06:21.913Z|FIXATIONDATA|369.73,715.79;17.47%,8.83%;<TEXT\_LINE> 2017-11-12T01:06:21.915Z|FIXATIONEND|332.62,721.53;11.03%,35.74%;<TEXT\_LINE> 2017-11-12T01:06:21.915Z|HEAD|6.08,107.60,702.73;-0.27,0.19,-0.07 2017-11-12T01:06:21.918Z|GAZE|357.64,718.33;15.37%,20.74%;<TEXT\_LINE> 2017-11-12T01:06:21.933Z|GAZE|326.13,723.11;9.91%,43.14%;<TEXT\_LINE> 2017-11-12T01:06:21.938Z|HEAD|6.08,107.60,702.73;-0.27,0.19,-0.07 2017-11-12T01:06:21.986Z|HEAD|6.08,107.60,702.73;-0.27,0.19,-0.07 2017-11-12T01:06:32.174Z|BLUR| 2017-11-12T01:06:32.175Z|ACTIVE|GazeReader.exe;Dialog 2017-11-12T01:37:11.421Z|REASON|distraction 2017-11-12T01:37:11.440Z | FOCUS | 2017-11-12T01:37:11.449Z|GAZE|872.82,534.01;4.50%,7.96%<TEXT\_LINE> 2017-11-12T01:37:11.453Z|GAZE|871.96,532.24;2.08%,-0.34%<TEXT\_LINE> 2017-11-12T01:37:11.456Z|GAZE|871.53,528.94;0.06%,97.28%; <TEXT\_LINE> 2017-11-12T01:37:11.458Z|FIXATIONDATA|871.52,532.08;0.85%,-1.09%<TEXT\_LINE> 2017-11-12T01:37:11.462Z|FIXATIONDATA|871.00,529.17;-0.04%,98.36%;<TEXT\_LINE> 2017-11-12T01:37:11.467Z|FIXATIONDATA|871.55,524.30;0.06%,75.53%;<TEXT\_LINE>

Predicting Self-Interruptions

- 1. Segment readings into Normal Reading, t seconds before an Interruption, and Invalid
- 2. Split Normal Reading into chunks of t seconds
- 3. Compare Normal chunks to Interruption chunks

### Data Cleansing

Problem: **Varying Data Quality** Solutions:

- Inspect and verify quality of data.
- Manually exclude low-quality regions

# GazeVis: What can you do?

| Inspect | Normal Reading, t seconds before an Interruption, and Invalid time chunks                         |
|---------|---|
| Mark    | Interactively mark areas that are invalid   |
| View    | Predictions of time chunks to be classified as Normal Reading or t seconds before an Interruption |
| Run     | Prediction once finished cleaning   |

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#### Demo

| GazeVis  | PREDICT  |
|--|--|
| Fixation Count per Second  Normal Reading Reading before Interruption  | Invalid Data   |
| Reading 1  |  |
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| Reading 3  | hadio hithe da   |
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# Analysis

| System      | GazeVis  |
|-------------|--|
| What: Data  | Readings: Time series data of fixation events, and tagged interruptions                                    |
| Why: Tasks  | Analyze gaze pattern, Locate problematic data, Query cleansed data with prediction                         |
| How: Encode | Sparklines and Steplines for the fixation<br>events, Area marks to color reading<br>segments by type, List |
| How: Facet  | Partition into two views with same encoding, overview-detail.  |
| How: Reduce | Brush a sparkline area and zoom in   |
| Scale       | 24 Readings, 100+ interruptions  |

# Future Work

Improved automatic cleaning

- Additional zooming in the predict view for inspecting segments, their associated features, and classification
- Better, more advanced prediction algorithms
- Navigation tour of the interface

## Questions?