Generating and Using Gaze-Based Document Annotations

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Gaze Data Indicates User Attention

Gaze data contains very valuable information when working with documents:

- It reveals the *position of the focus point of attention*
- By detecting reading and skimming behavior, we have an indicator for the *attention intensity*

Utilization

- Detect reading and skimming behavior
- Map the gaze data to actual text lines
- Create text annotations

Possible Applications

- Recontextualization
- Enhancing and personalizing document search especially concerning re-finding
- Searching for attention patterns

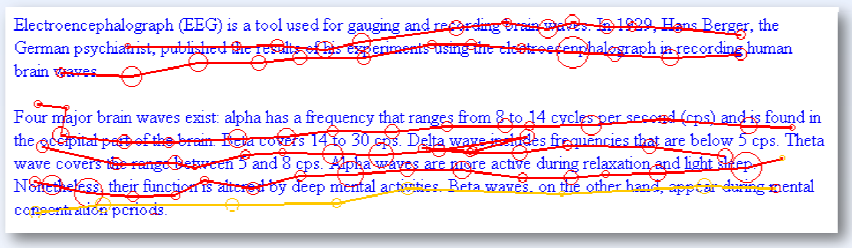
From Gaze Data to Document Annotations

Eye Tracking

- Desk-mounted, unobtrusive eye tracker (Tobii)
- 50 Hz data generation frequency for both left and right eye
- Accuracy ~ ± 40 pixel

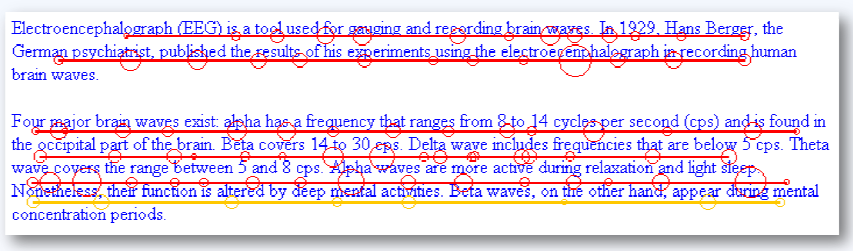
1. Reading and Skimming Detection

Reading and skimming behavior can be detected by analyzing the user's sequence of saccades (jumps) over text.



2. Flattening the Lines

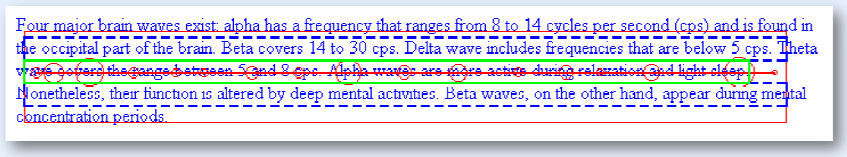
The zigzag gaze lines get flattened by simple horizontal averaging.



Up to here, text layout information is not considered at all.

3. Line Matching

By applying OCR methods (Optical Character Recognition), the text lines corresponding to the gaze lines can be assessed. This is done line by line.



Two heuristics to enhance line-matching:

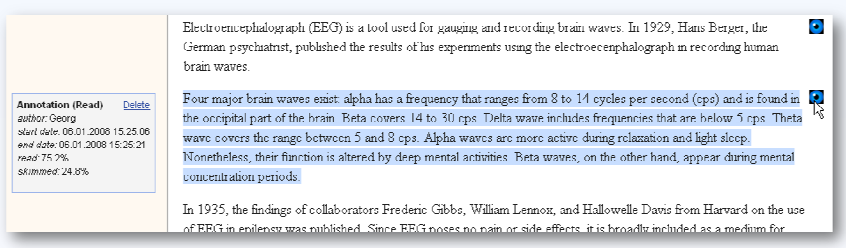
- *Recalibration on the fly*: vertical difference between gaze line and most plausible text line can be used as error correction bias for the next gaze lines.
- *Next line heuristic*: reading behavior of longer text parts is typically sequential (line after line). If a gaze line lies between two text lines, the *predicted* "next line" gets a higher weight.

4. Creating Gaze-Based Annotations

First, annotations are created line by line.
Second, they are coarsened on the level of paragraphs:

- Nearby annotations are merged
- Small text parts between two annotations that are not marked as read are included nevertheless

We use a semantic wiki for storing the annotations:



A gaze-based annotation contains information about

- the creator (the reader)
- the time and date
- the percentage of reading vs. skimming behavior of the annotated text part

Exemplary Ideas for the Exploitation of Gaze-Based Document Annotations

Recontextualization

If you re-open a long text book and want to re-find the chapter that has been of interest to you one week ago, you can just filter the intensely viewed document parts.

Such functionality could help to create a quick memory flashback. It is especially useful for knowledge-workers who deal with many (long) documents and different work contexts.

Personalized Search Result Abstracts

When trying to re-find information, the search engine can incorporate the documents' attention annotations for result list presentation:
Search result abstracts should be influenced by the viewing intensity of the different document parts. The more intense a part has been viewed, the higher is the probability for recognizing it at a later time.

Searching for Something Known or Unknown?

In a desktop search scenario: Do you want to
1) re-find known information or are you trying to
2) find something new?

1. Search engine just considers read/skimmed document parts.
2. Search engine only considers
   - not viewed text parts
   - roughly skimmed (not noticed) text parts
   - parts that have been read a long time ago (forgotten).

Searching for Similar Attention Patterns

By comparing one's own fine-grained attention patterns with those of others, a recommendation system could suggest text snippets that were interesting to others in the same informational context.

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