

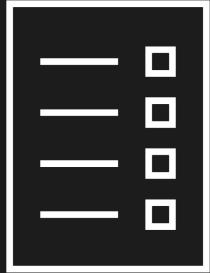


# Adaptive Speed Reading

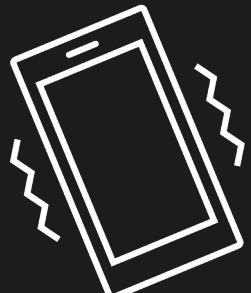
Pushing the Limits of Accelerated Reading

Matis Bodaghi, Evangelos Georgiadis, Jack Hau, Kyoya Higashino, Konstantinos Mitsides, Fadi Zahar

Dr. Konstantinos Gkoutzis



# Information Overload





## Speed-Reading Techniques

### *Rapid Serial Visual Presentation (RSVP)*

- displays words sequentially at a fixed location on the screen



### *Chunking*

- groups words into larger, more manageable or meaningful units

## Main Challenge

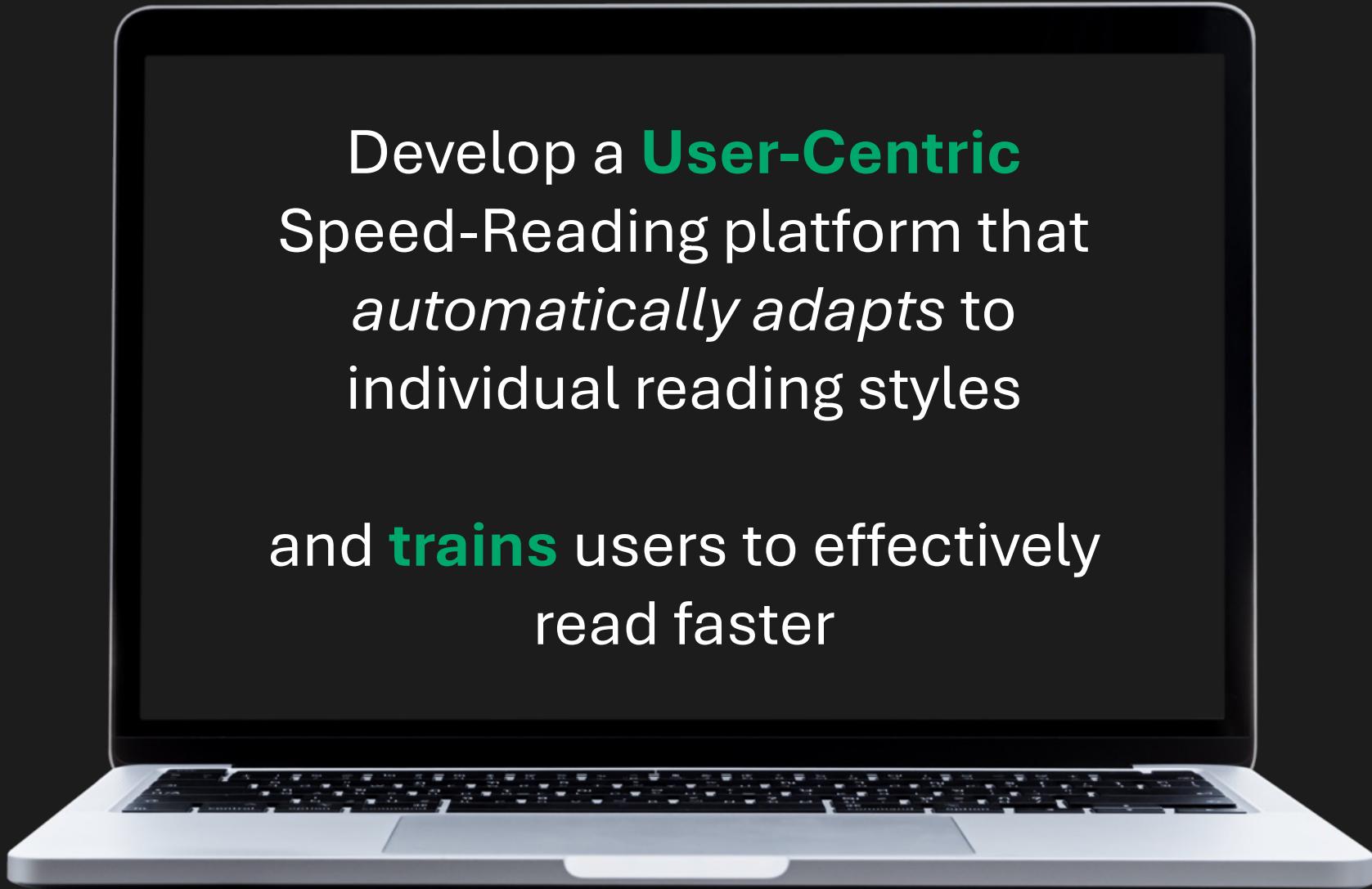
Balancing reading speed with effective comprehension and retention...



## *Speed-Reading Platform*

Develop a **User-Centric**  
Speed-Reading platform that  
*automatically adapts* to  
individual reading styles

and **trains** users to effectively  
read faster



# Kiraka's Solution



- ✓ (Transferrable/  
Applicable/Realistic  
Training)
- ✓ User-Centric  
Adaptiveness

# WebGazer (1)

## Table of content

$$\text{WPM} \Leftrightarrow \text{Chunk Display Time}$$

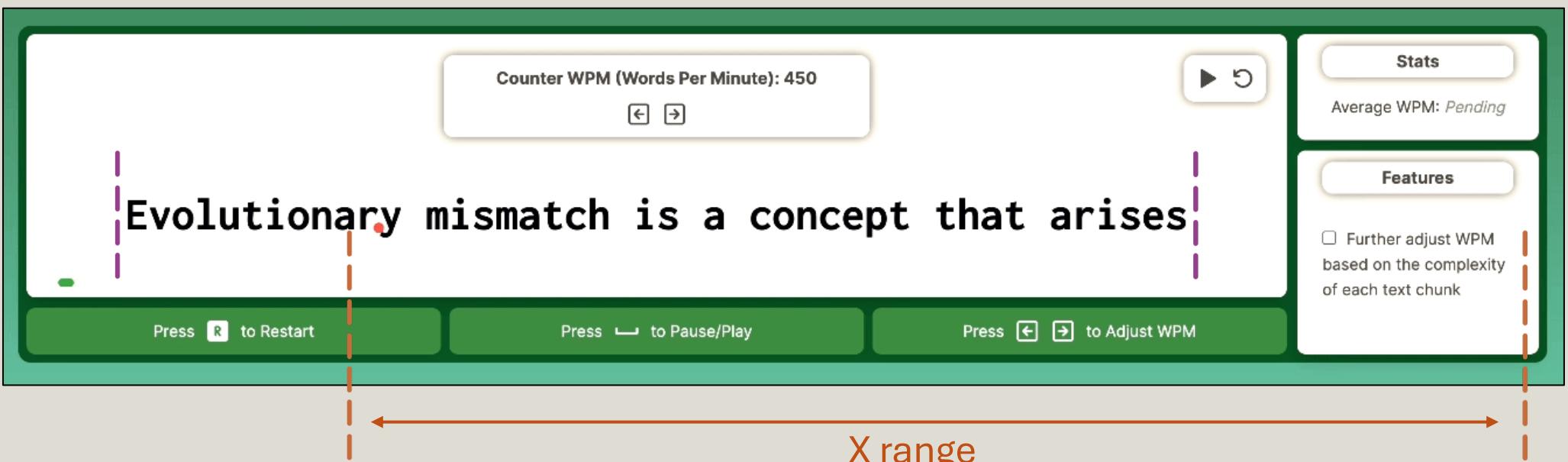
Webgazer

LLM

Tech Stack

User Trial

Evaluation



Gaze data is **unstable** and **inaccurate in absolute positions**, heavily dependent on initial calibration.

*we shifted our focus to using relative gaze positions.*

# Everything is Relative, Right?

Table of content

Webgazer

LLM

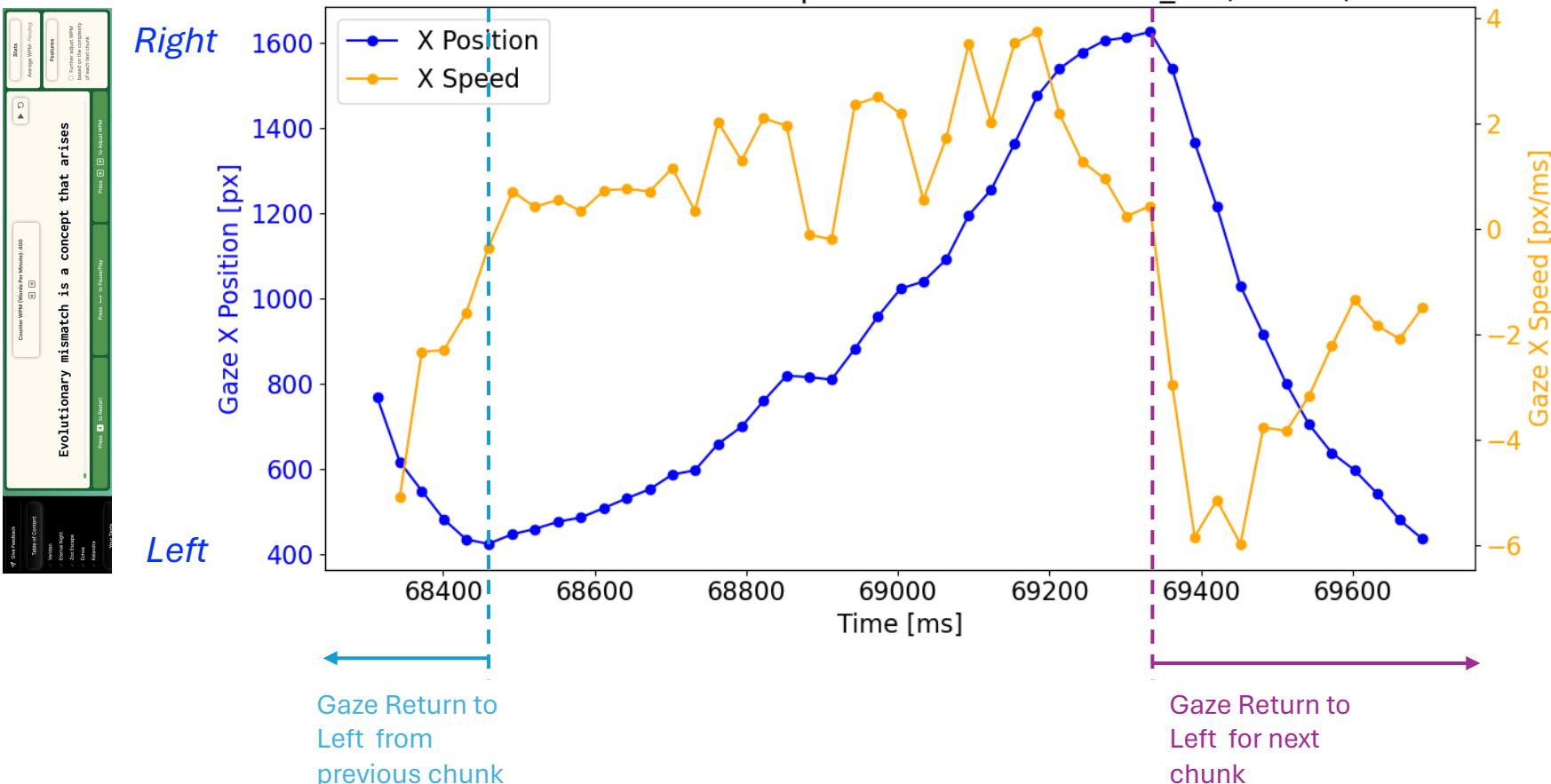
Tech Stack

User Trial

Evaluation

F Fadi

*let's focus on relative gaze positions, extending to gaze velocities*



## Table of content

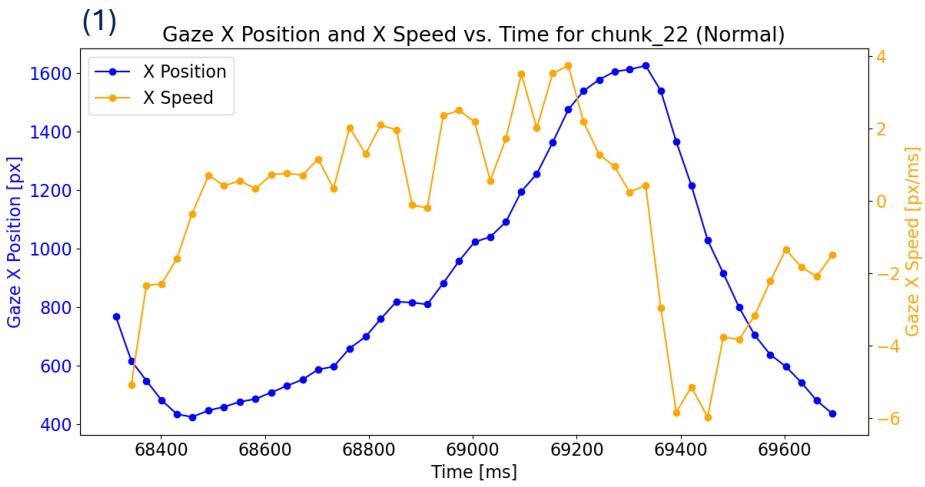
## Webgazer

## LLM

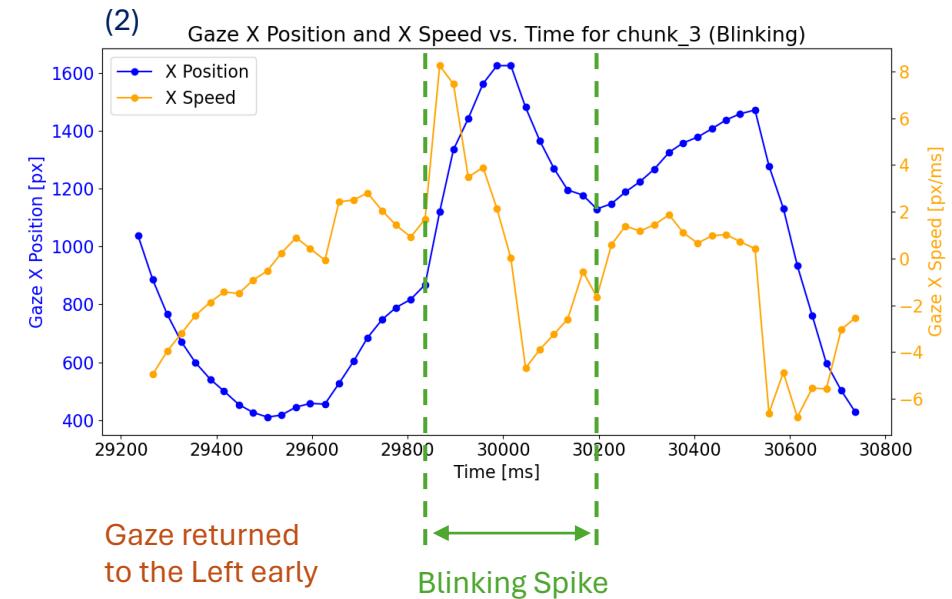
## Tech Stack

## User Trial

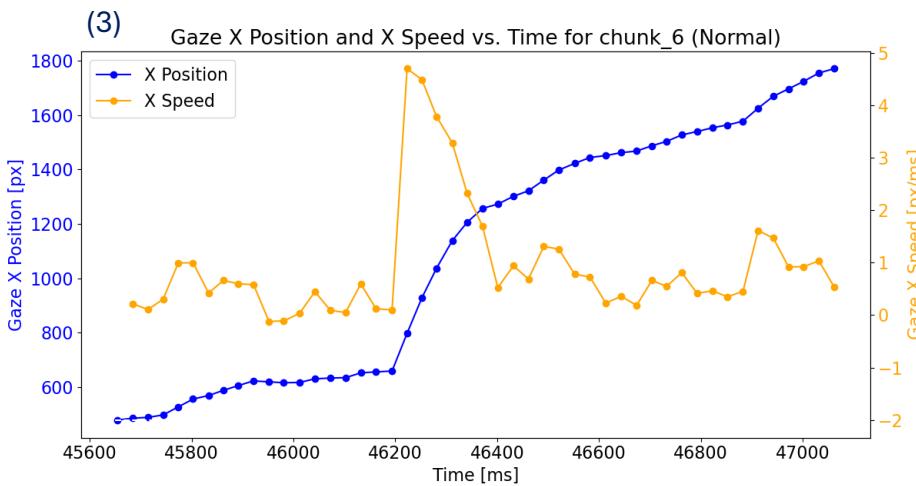
## Evaluation



Gaze returned  
to the Left early



Gaze returned  
to the Left early



Gaze did not return  
to the Left early

Table of content

Webgazer

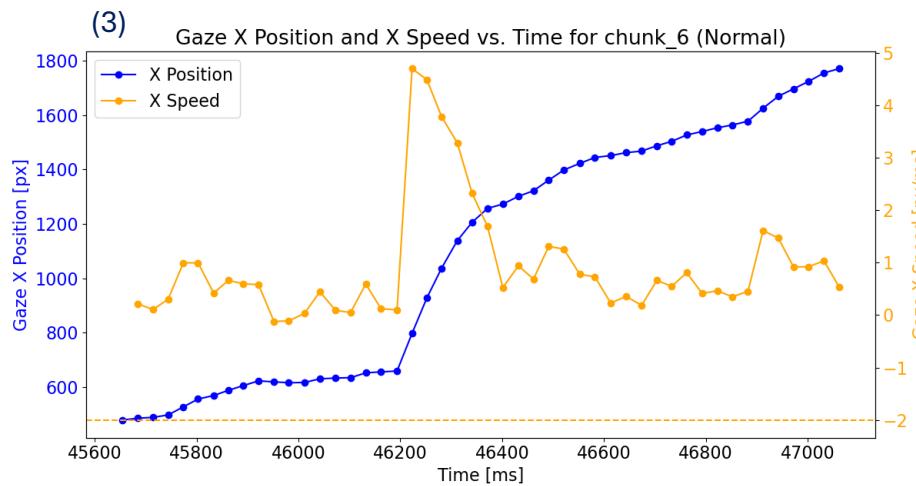
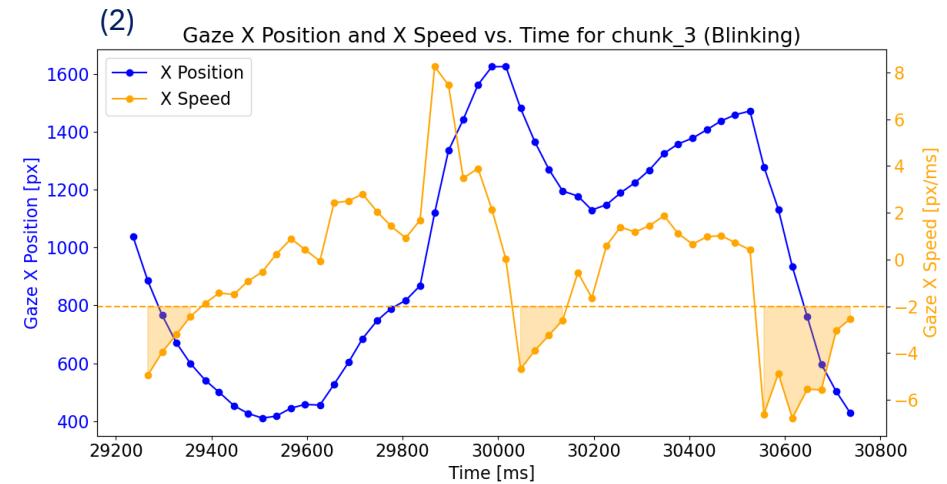
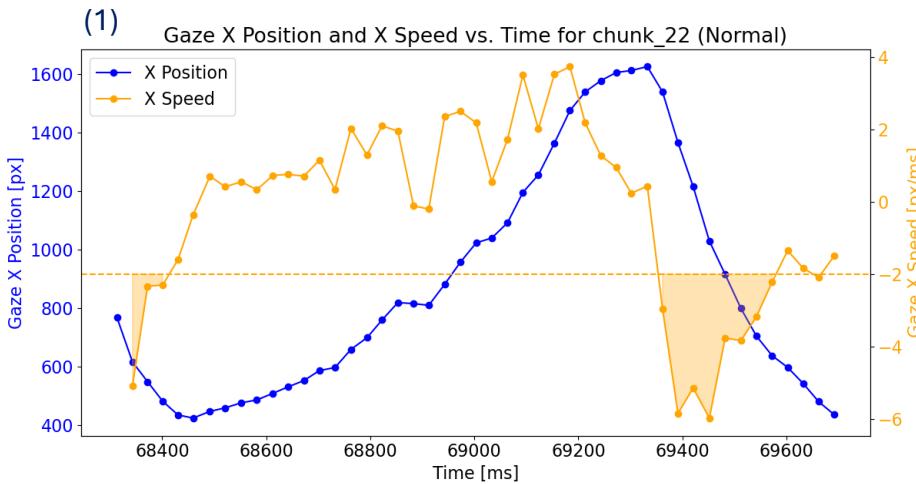
LLM

Tech Stack

User Trial

Evaluation

F Fadi



Gaze speeds lower than -2px/ms consistently indicated a user's gaze returning to the left.  
Scaled by 1/1201px to apply to all device sizes

*Table of content*

Webgazer

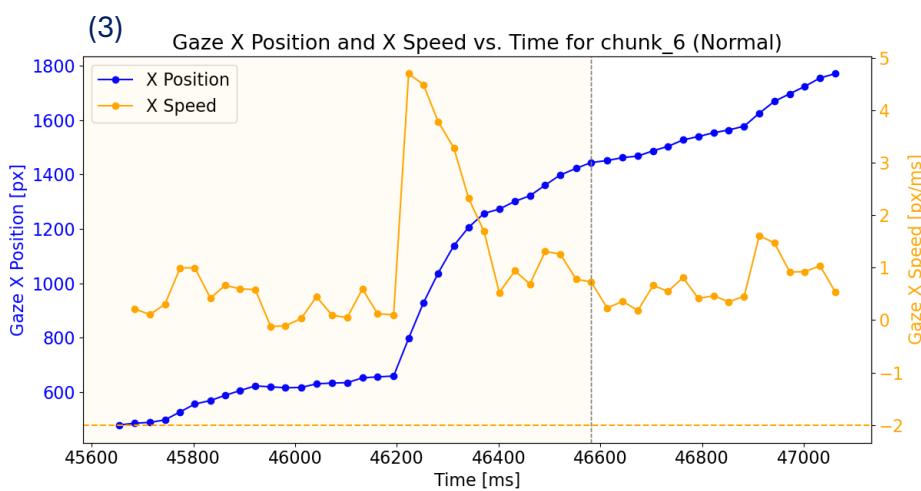
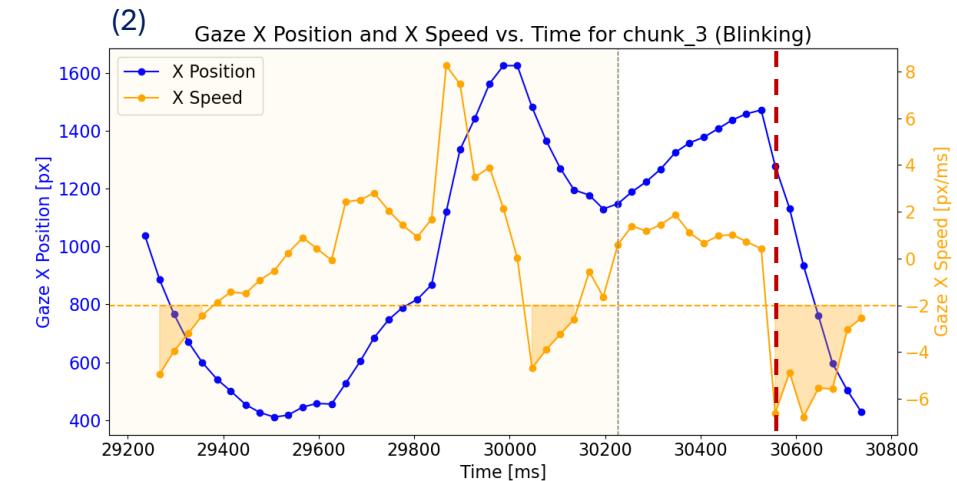
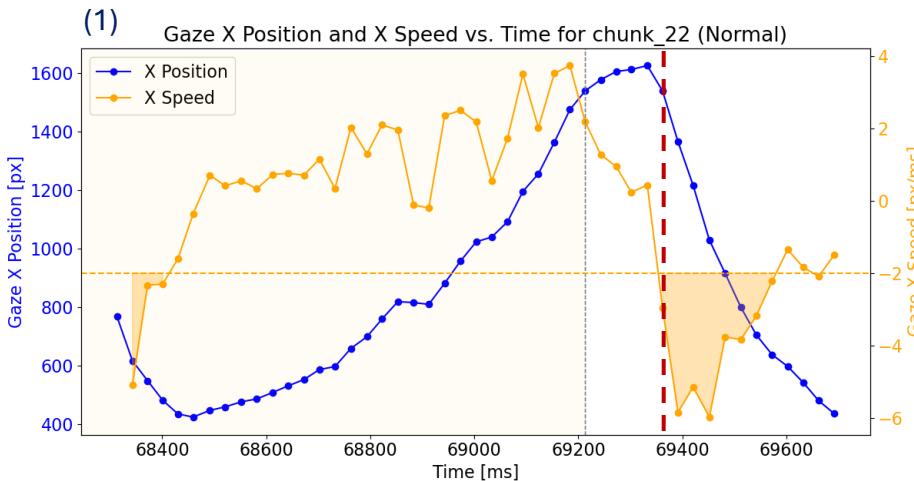
LLM

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F Fadi



Ignore first 65% of data

## Table of content

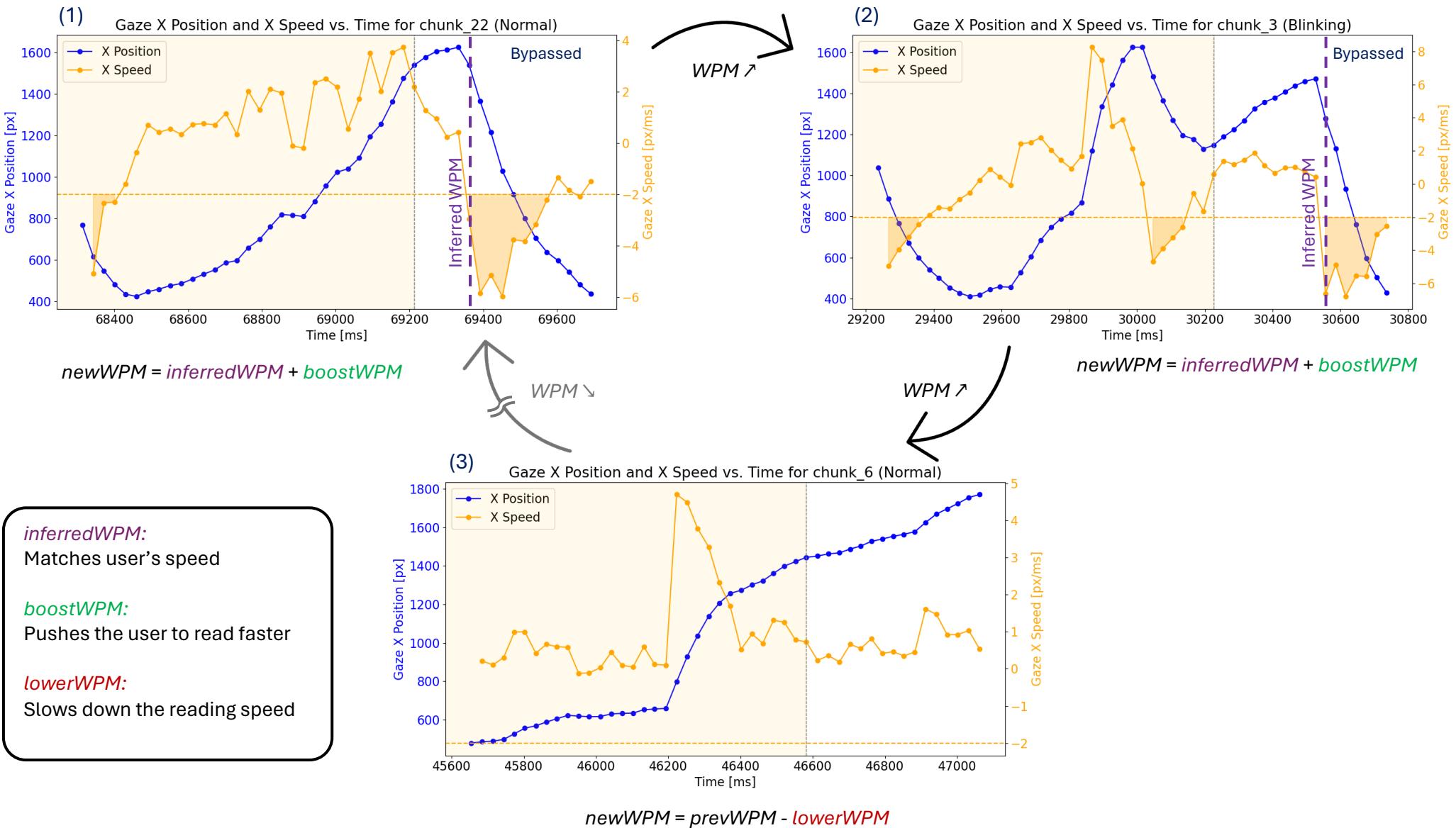
## Webgazer

## LLM

## Tech Stack

## User Trial

## Evaluation



# Some additions and LLM integration

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F Fadi

*More personalised:*

*Start WPM:* average of the last 10 performances for this mode

*More responsive and intelligent:*

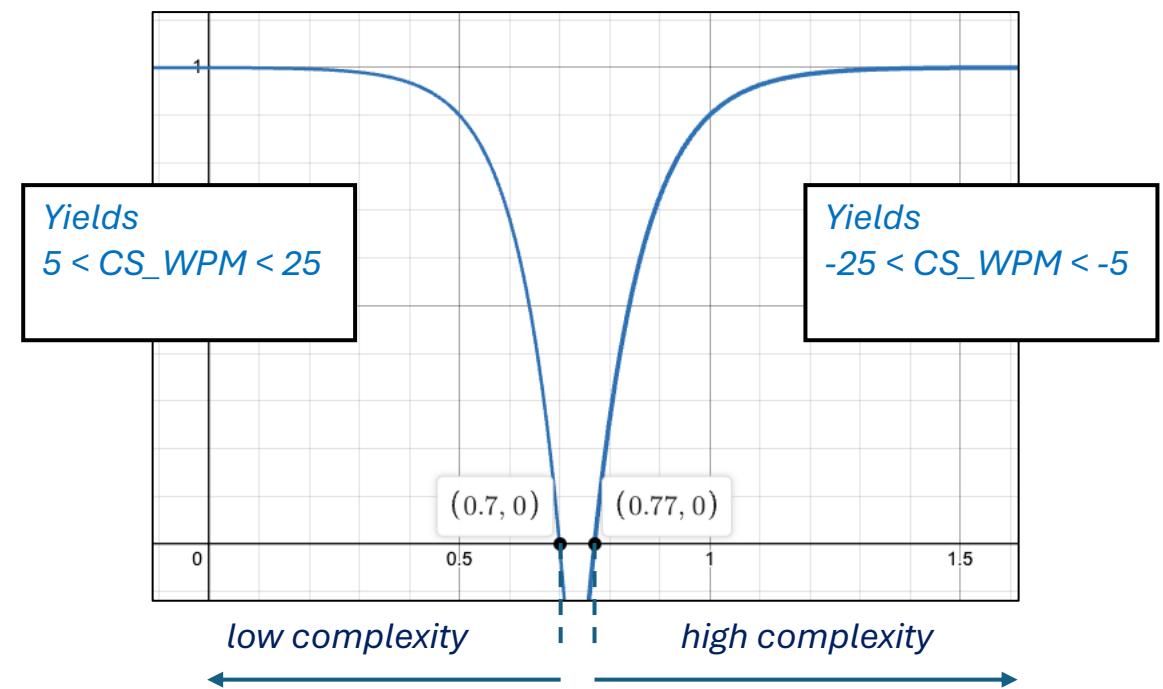
*Complexity Score CS:* Lexical complexity of the next chunk used for WPM adjustment

*WPM  $\uparrow$ :*

$\text{newWPM} = \text{inferredWPM} + \text{boostWPM} + \text{CS\_WPM}$

*WPM  $\downarrow$ :*

$\text{newWPM} = \text{prevWPM} - \text{lowerWPM} + \text{CS\_WPM}$



# LLM - Chunk Complexity

## Table of content

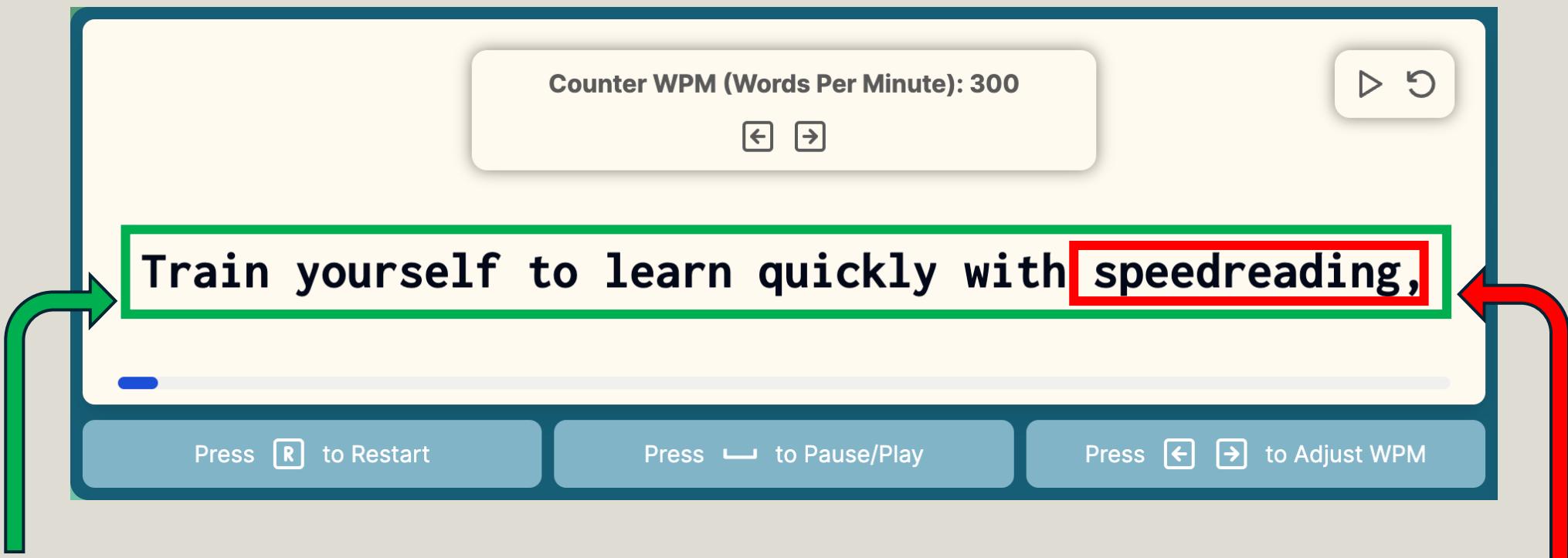
Webgazer

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## Contextual Complexity (LLM-based)

- *Model:* BERT-base
- *Dataset:* SemEval-2021 Lexical Complexity Prediction
- *Inputs:* outer CONTEXT phrase, inner TARGET phrase
- *Output:* 0 to 1

## Longest Word Complexity

- Regularising Term
- *Linear function:*  $y = 0.02x$
- Output: 0 to 1

# LLM - Quiz Generation

## Table of content

Webgazer

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Evaluation

**Goal:** develop a pipeline for creating MCQs from uploaded texts

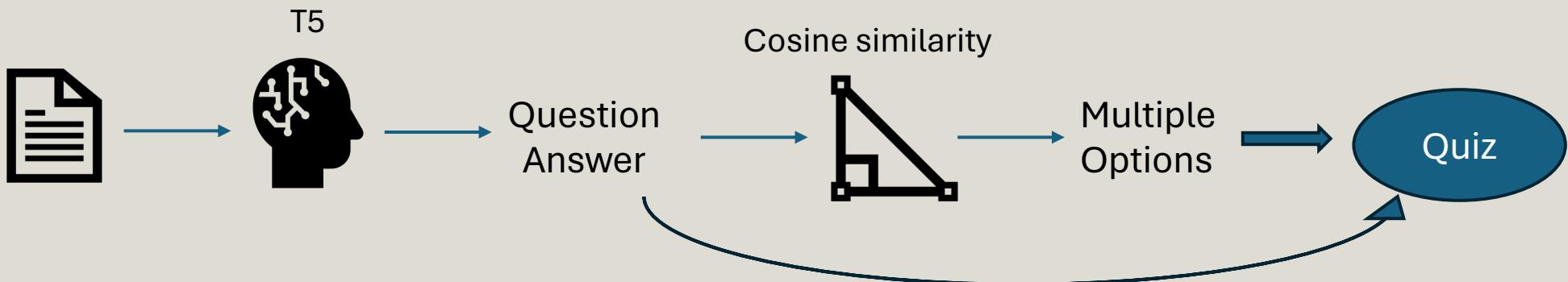
**Extractive Approach:** generates new text by directly copying key phrases from source text

**Challenges:**

- limited token range → repetitive questions
- no plausible false answers

**Solutions:**

- texts divided into sections and each section is input to the LLM
- cosine similarity to identify contextual similar phrases



# LLM - Quiz Generation

## Table of content

Webgazer

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Evaluation

**Goal:** develop a pipeline for creating MCQs from uploaded texts

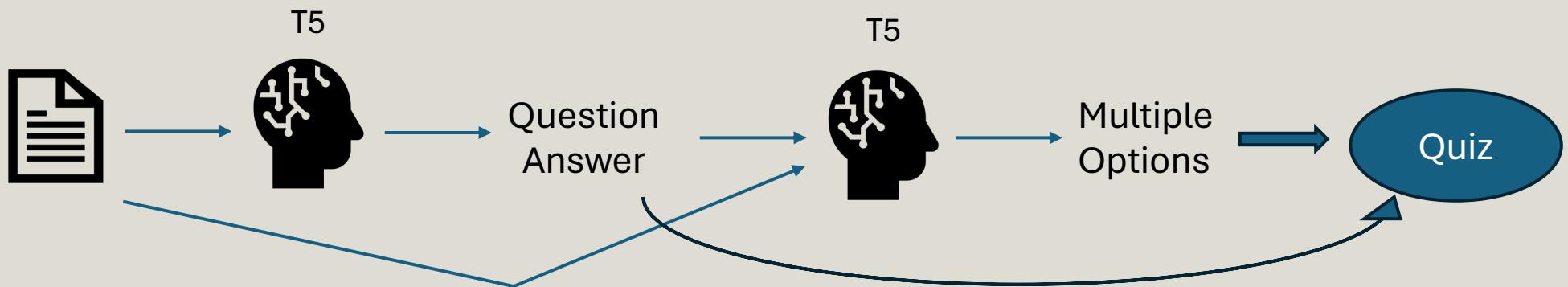
**Abstractive Approach:** generates new text by synthesising info from source text

**Advantages:**

- better at assessing overall understanding

**Limitations:**

- ~ 50% error rate
- some irrelevant questions



# Kiraka's Tech Stack

## Table of content

Webgazer

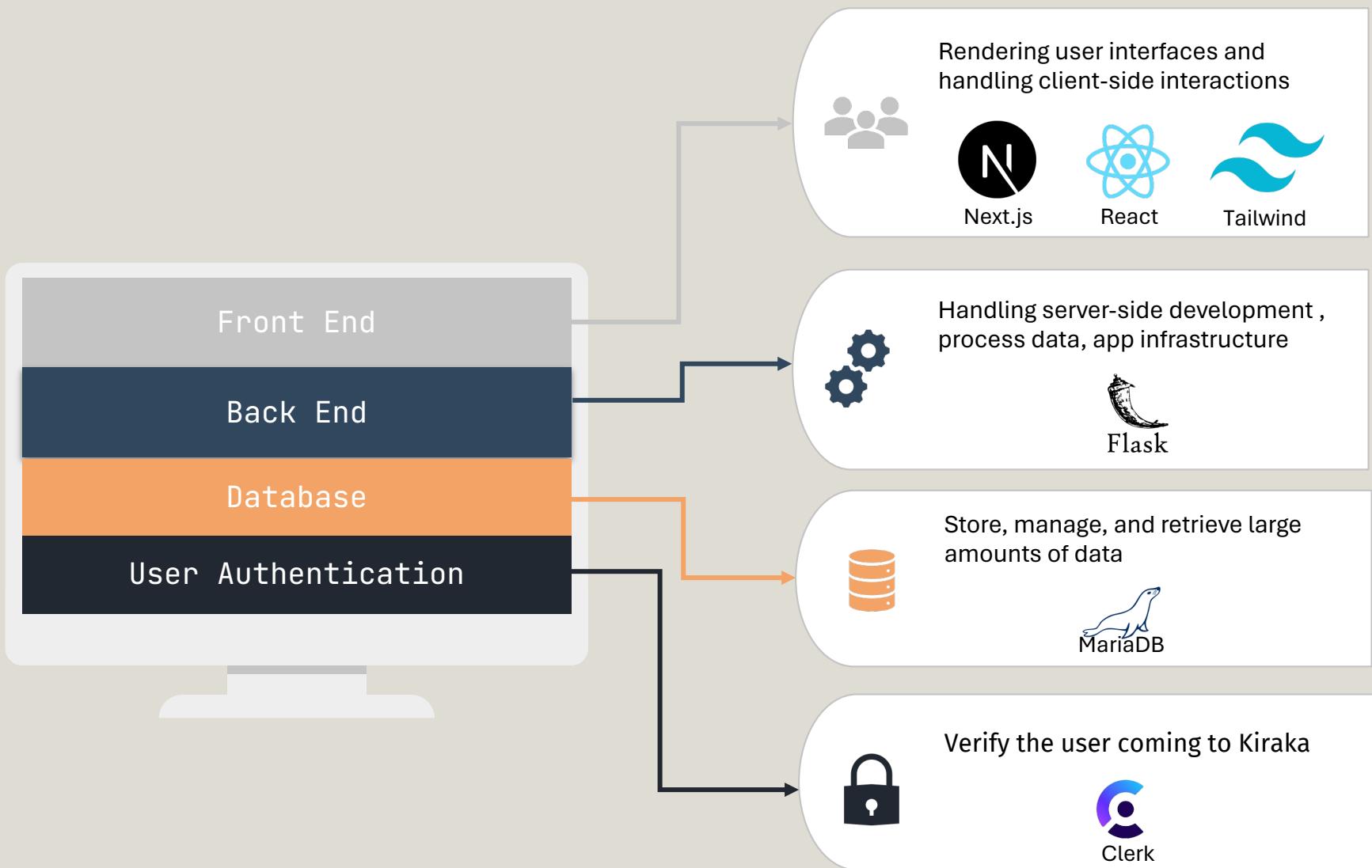
LLM

Tech Stack

User Trial

Evaluation

J Jack



# Kiraka's Tech Stack

## Table of content

Webgazer

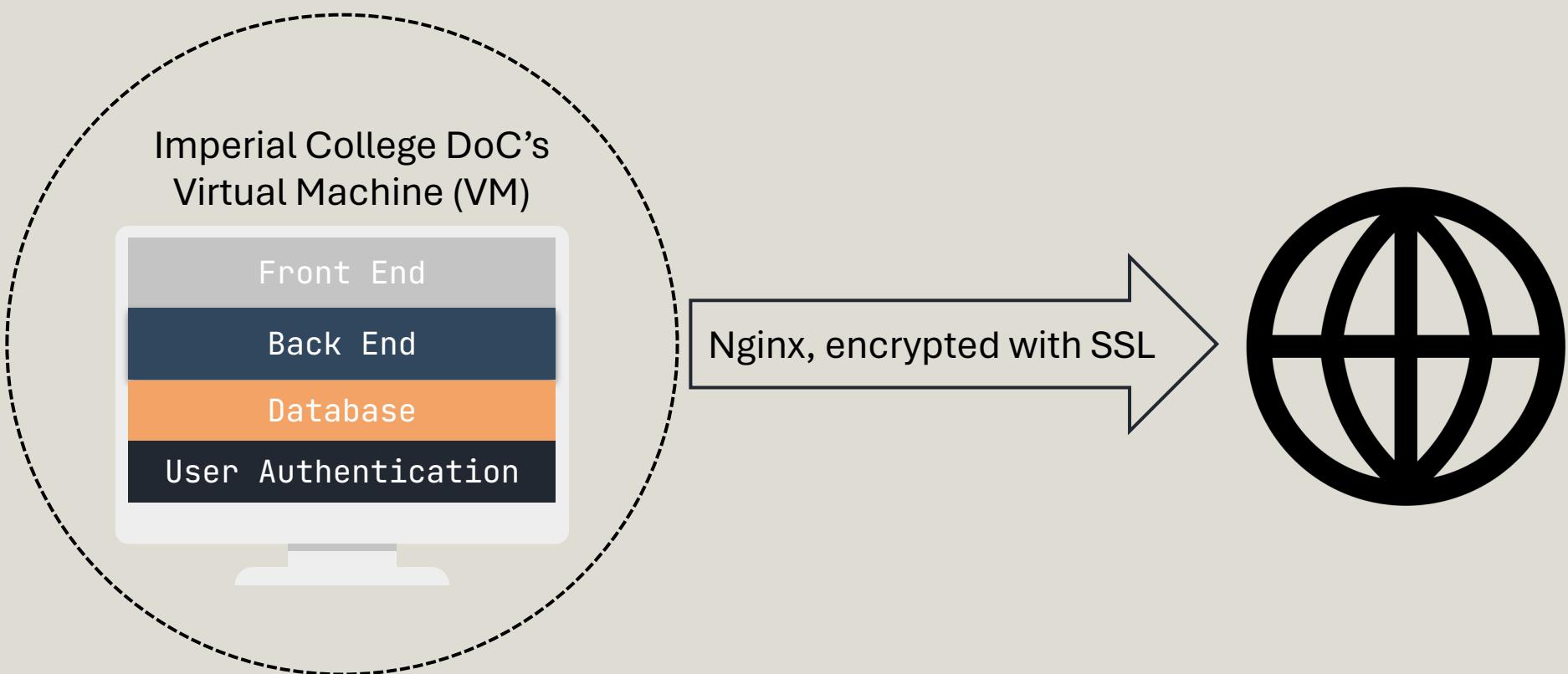
LLM

Tech Stack

User Trial

Evaluation

J Jack



# User Trials - Setup

## Table of content

Webgazer

LLM

Tech Stack

User Trial

Evaluation

## Goal: Feedback Driven Development

### *Key points:*



- **60 users across 3 trials**



- **5 unique texts per trial**



- **Prompt engineered texts**



- **Data privacy –**  
7 principles of GDPR

### *Specific Objectives:*

- **UI/UX feedback**
- **Performance Analytics**
- **Evaluation of Features**

# User Trials - UX/UI

## Table of content

Webgazer

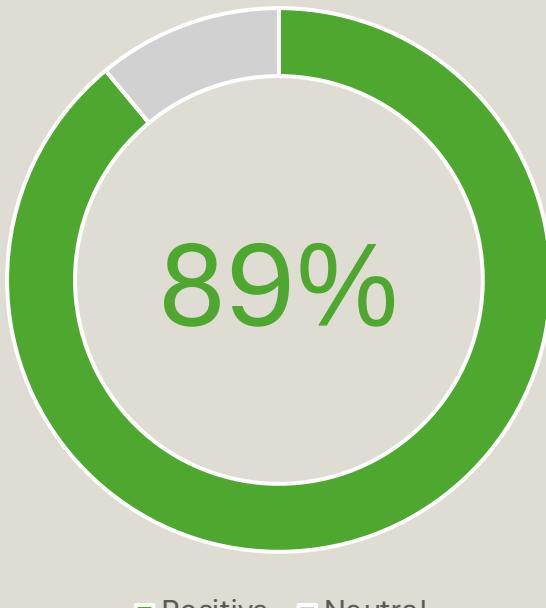
LLM

Tech Stack

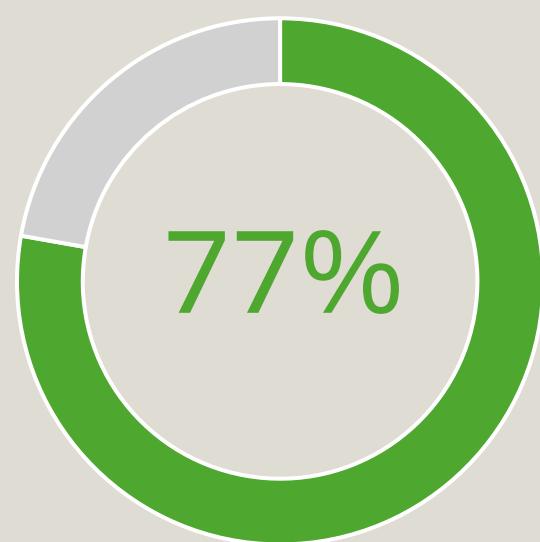
User Trial

Evaluation

### Overall Design



### Navigation and Layout



# User Trials - Performance Analytics

## Table of content

Webgazer

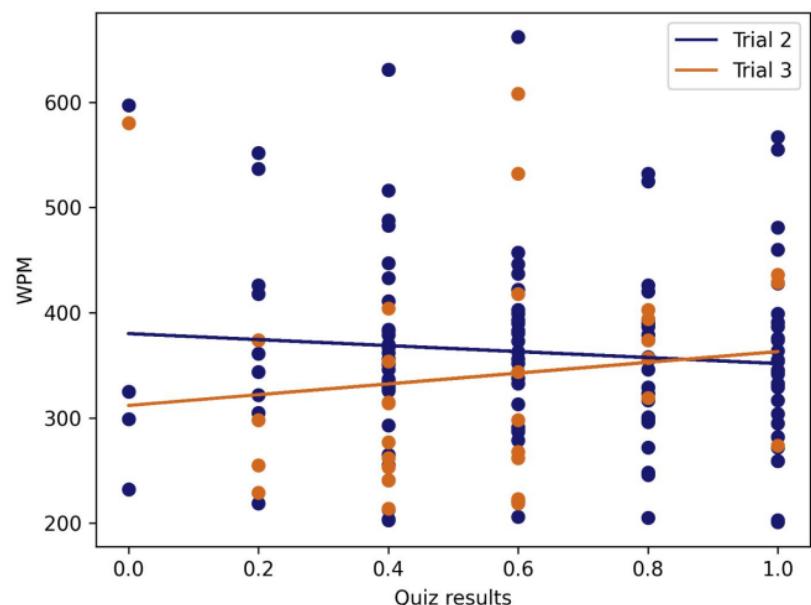
LLM

Tech Stack

User Trial

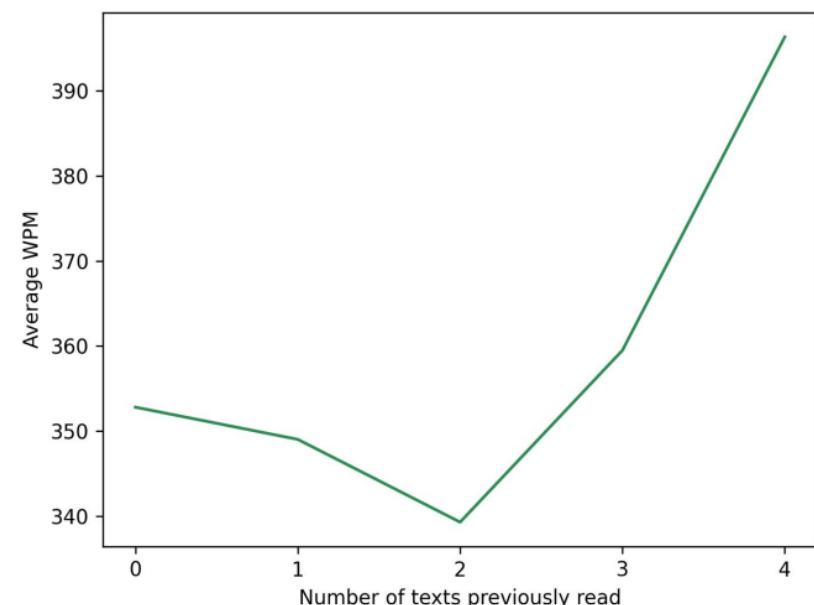
Evaluation

## Speed-Comprehension Trade-off



(a) Quiz results vs WPM, a quantitative measure of the speed-comprehension trade-off

## User Learning Curve



(b) Quantified learning curve using the average WPM of user as they continue to train on the Kiraka platform

Figure 3: Quantitative analysis of user trials results

# User Trials - FlashMode

## Table of content

Webgazer

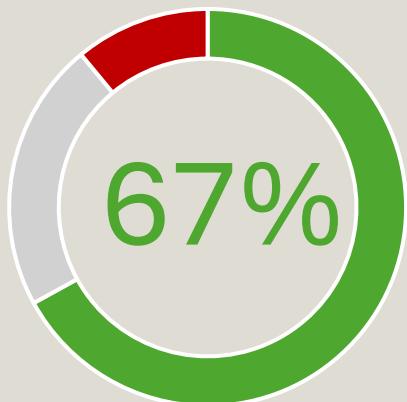
LLM

Tech Stack

User Trial

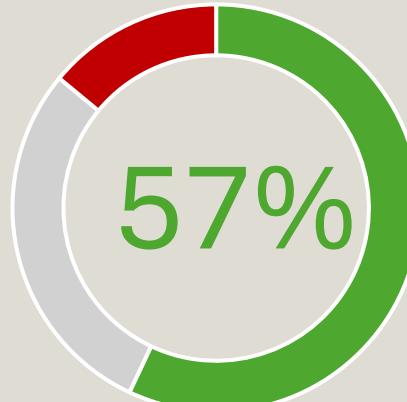
Evaluation

### FlashMode Adaptive



■ Positive □ Neutral ■ Negative

### Chunk Complexity



■ Positive □ Neutral ■ Negative

### Users Read Faster



■ Positive □ Neutral ■ Negative

# User Trials - Quizzes

## Table of content

Webgazer

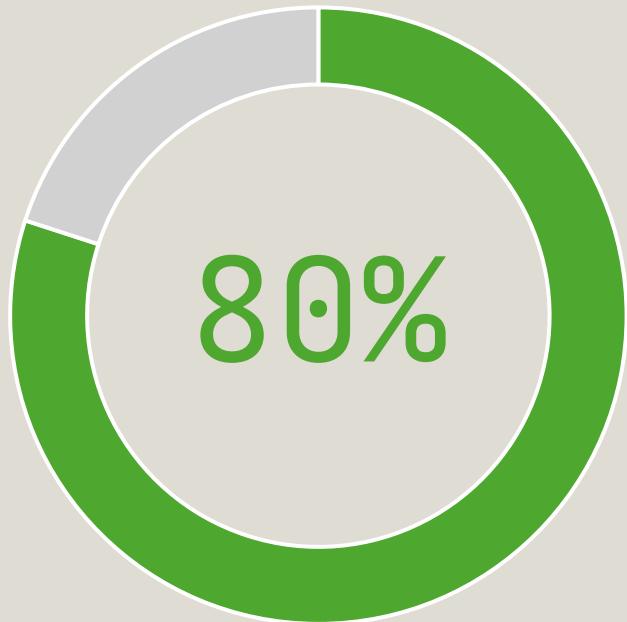
LLM

Tech Stack

User Trial

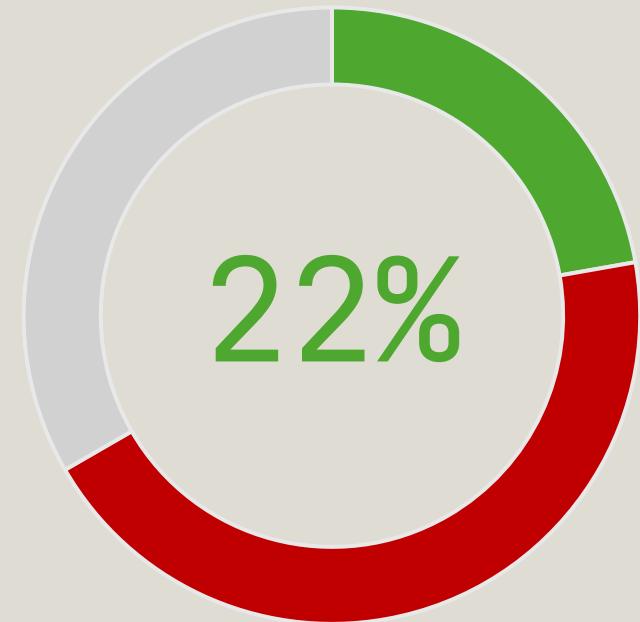
Evaluation

With Human Filter



■ Positive □ Neutral

With No Filter



■ Positive ■ Negative □ Neutral

# Evaluation - SWE

Table of content

Webgazer

LLM

Tech Stack

User Trial

Evaluation

E Evangelos

## Google Lighthouse



### Performance



Looking at various factors such as

- how fast it loads,
- how quickly it becomes interactive
- how smoothly it runs.

### Accessibility



Checking for screen reader support, keyboard navigation, colour contrast ratios, and more

### Best Practices



Recommendations on modern web dev best practices, covering everything from HTTPS usage to correct image aspect ratios

### Search Engine Optimisation



The website's ability to be indexed and ranked by search engines. It checks for structured data, meta tags etc



# Evaluation - Scalability

## Table of content

Webgazer

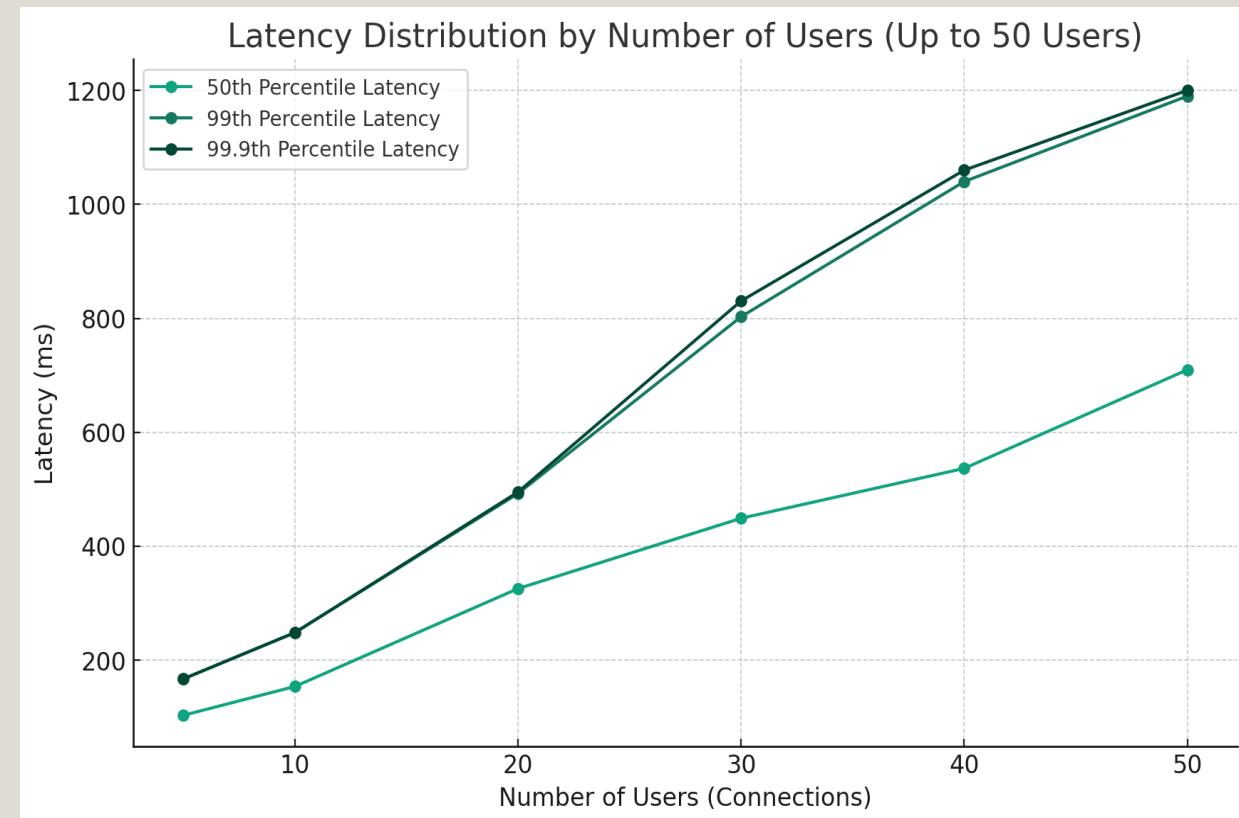
LLM

Tech Stack

User Trial

Evaluation

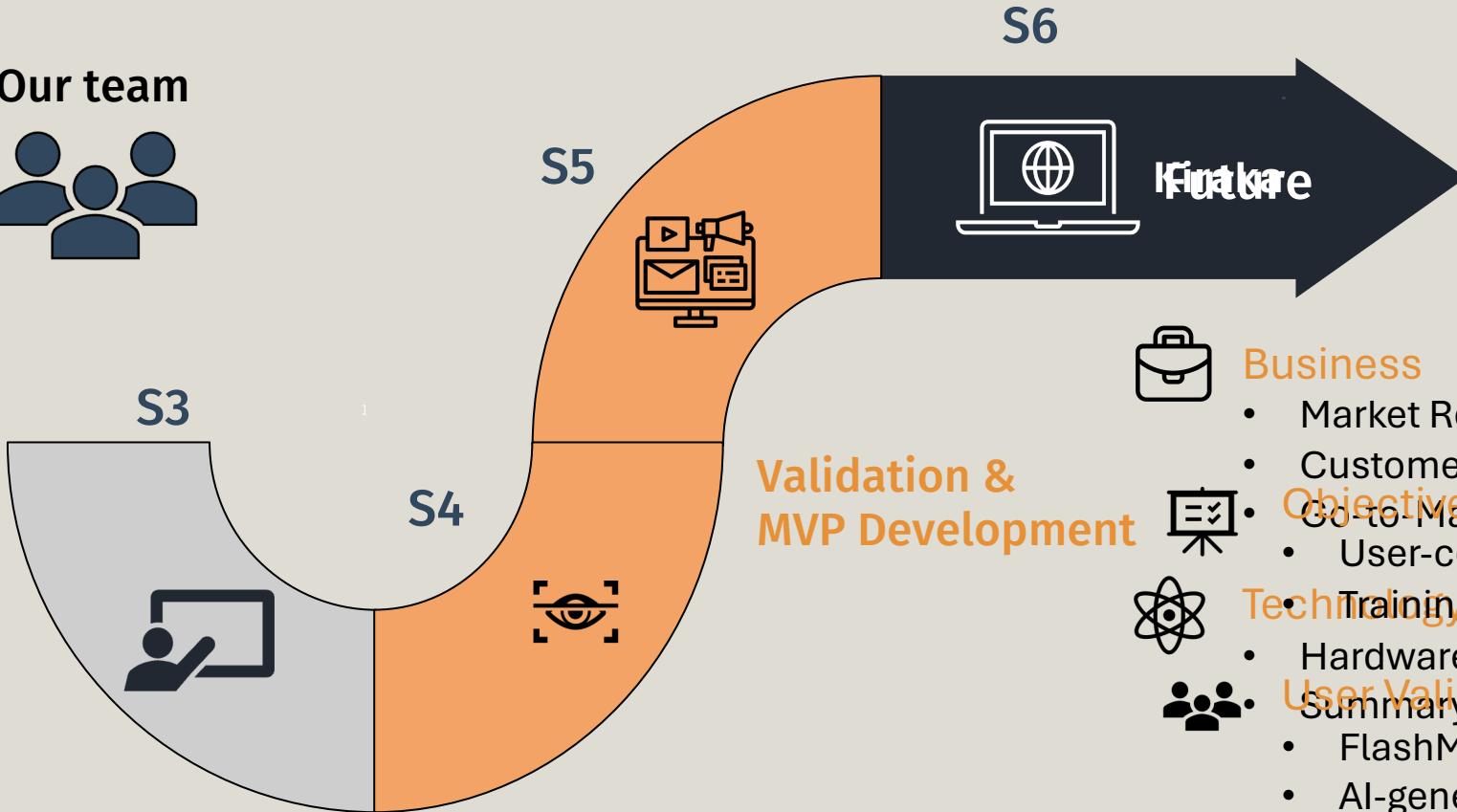
- Stress tests were carried out using WRK2
- Assumed an overestimate of 1 request every 5 seconds per user
- Acceptable performance for a limited number of users but potential scalability issues



# Conclusion & Future Work

---

## Our team



### Business

- Market Research
- Customer Segmentation
- Go-to Market Strategy
  - User-centric adaptivity



### Objectives



### Technology

- Hardware Upgrade in VM
- Summary generation
  - FlashMode challenges readers



### User Validation

- AI-generated quiz rated highly

# Live Tutorial

By Matis

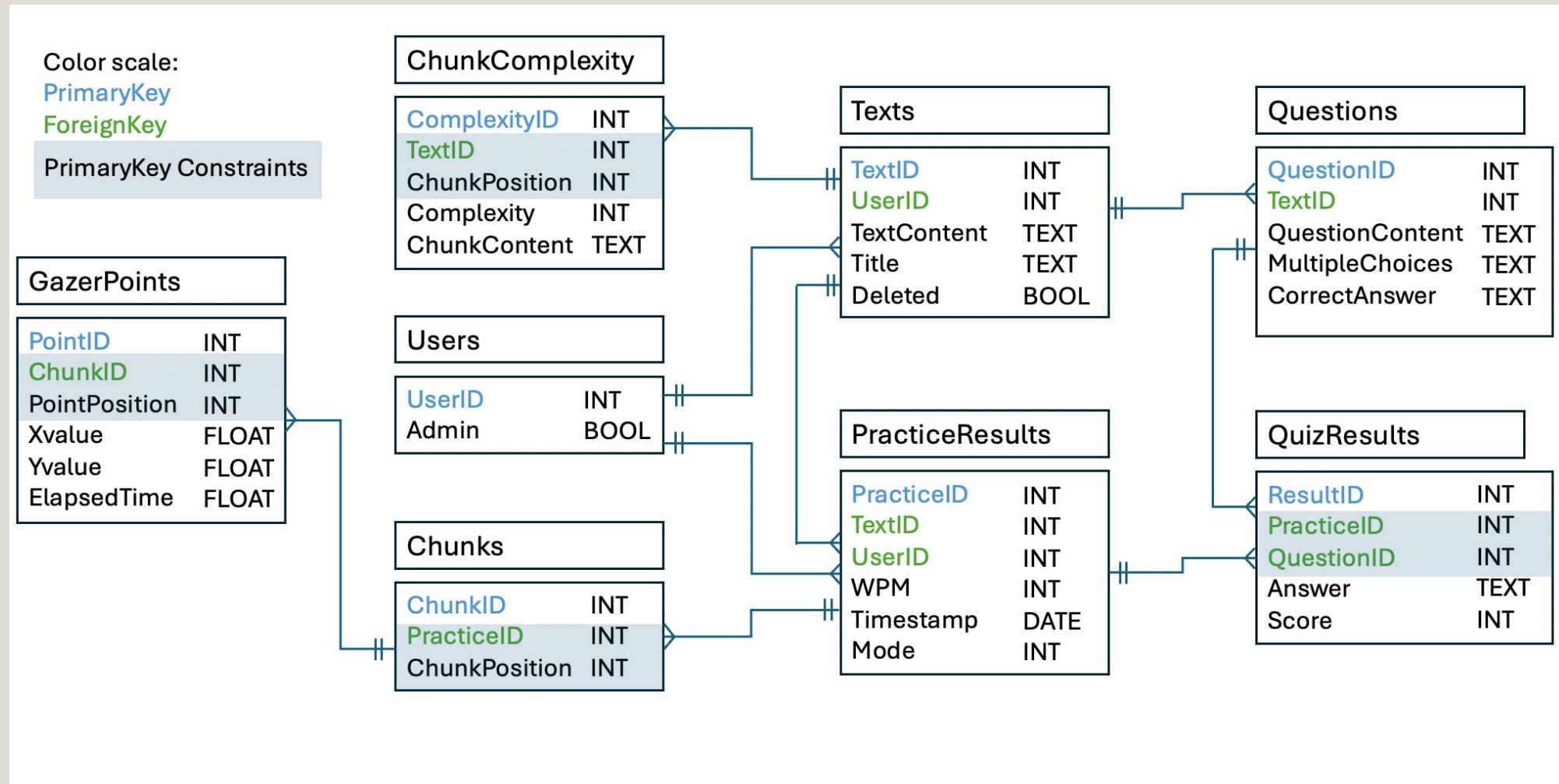
# Pioneering Speed-Reading Platform for Prof

Pushing the Limits of Accelerated Reading.

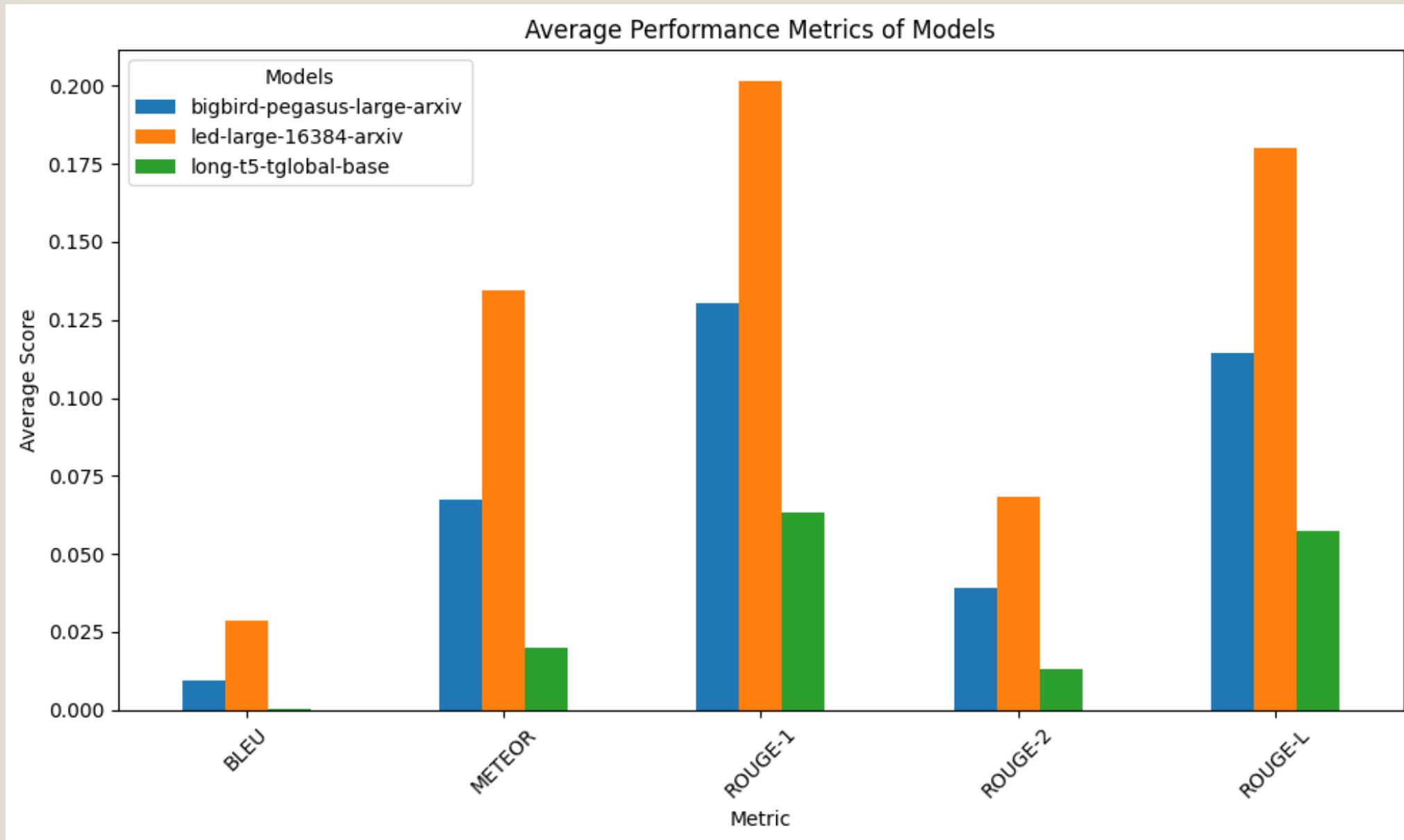
[Start Speed Learning Now](#)

# \*APPENDIX

# Database Diagram



# Summary Generation Performance



# Ethics & Privacy

policy outlines how personal data is collected, used, stored, and protected



lawfulness, fairness, and transparency

policy reminds user to upload only texts for which they hold rights



data minimisation & purpose limitation

policy informs users they can delete any text they upload



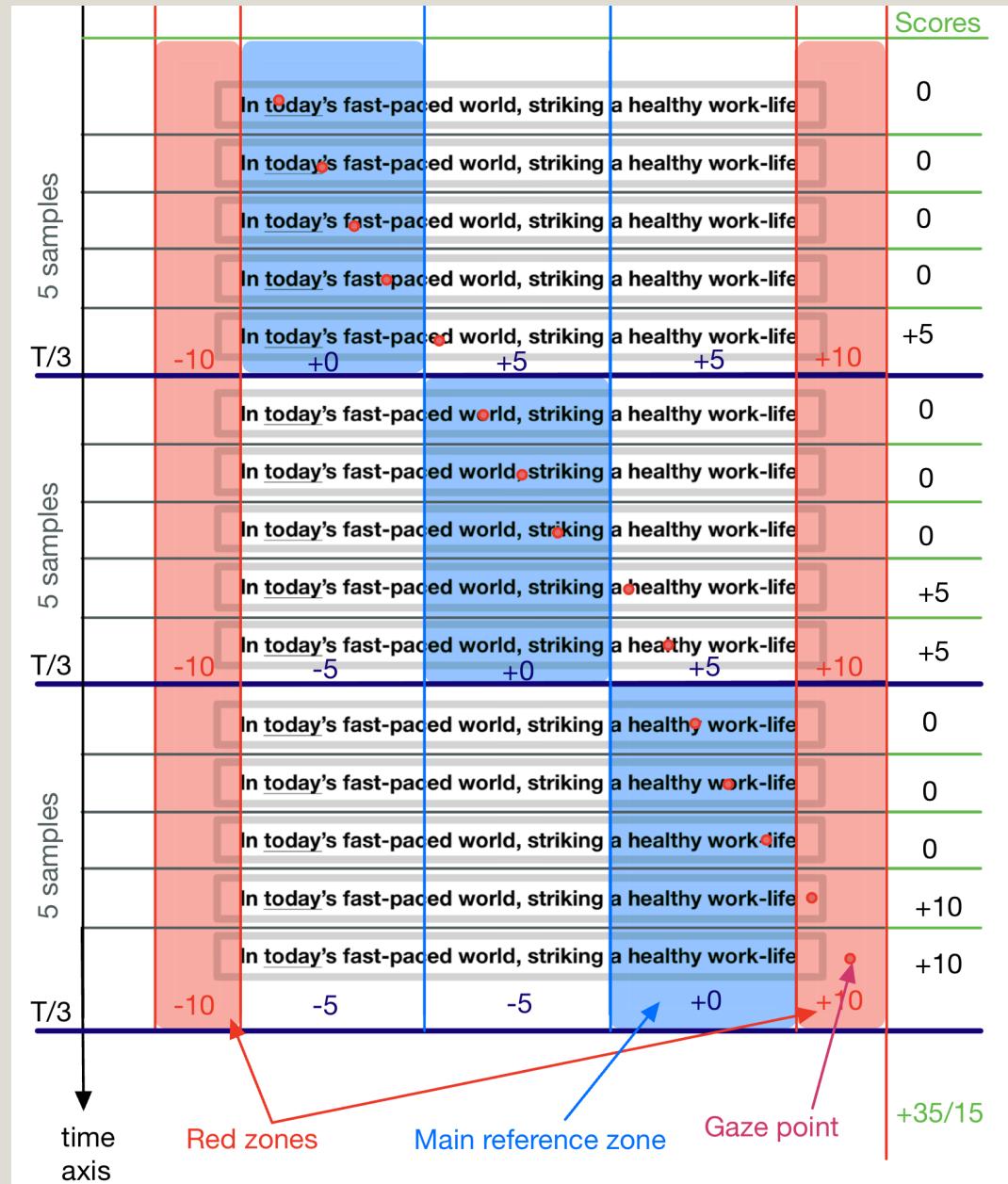
storage limitation

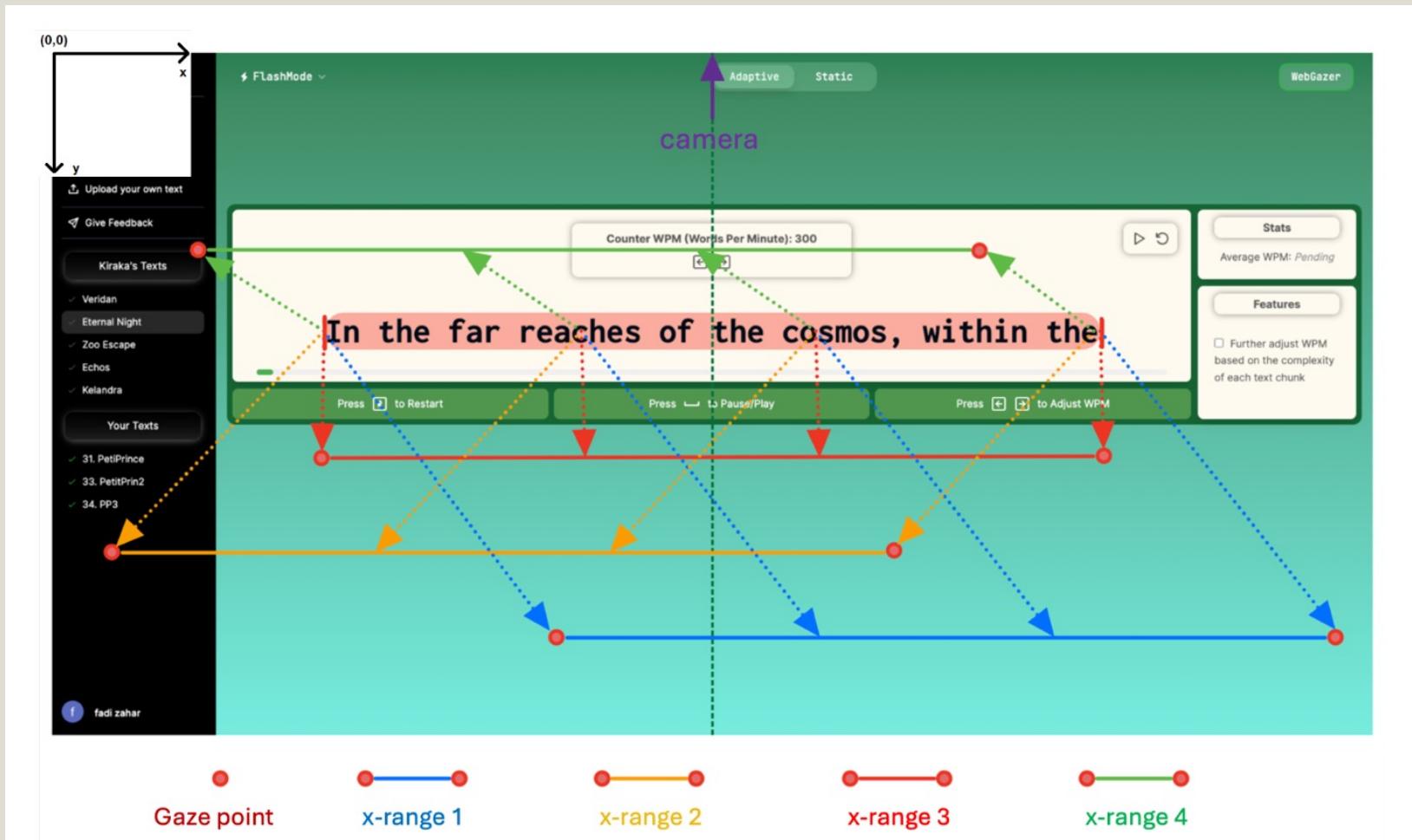
message indicating to users how video data is used from our side



integrity and confidentiality

# 1<sup>st</sup> FlashMode Attempt





# 2<sup>nd</sup> - 3<sup>rd</sup> FlashMode Attempts

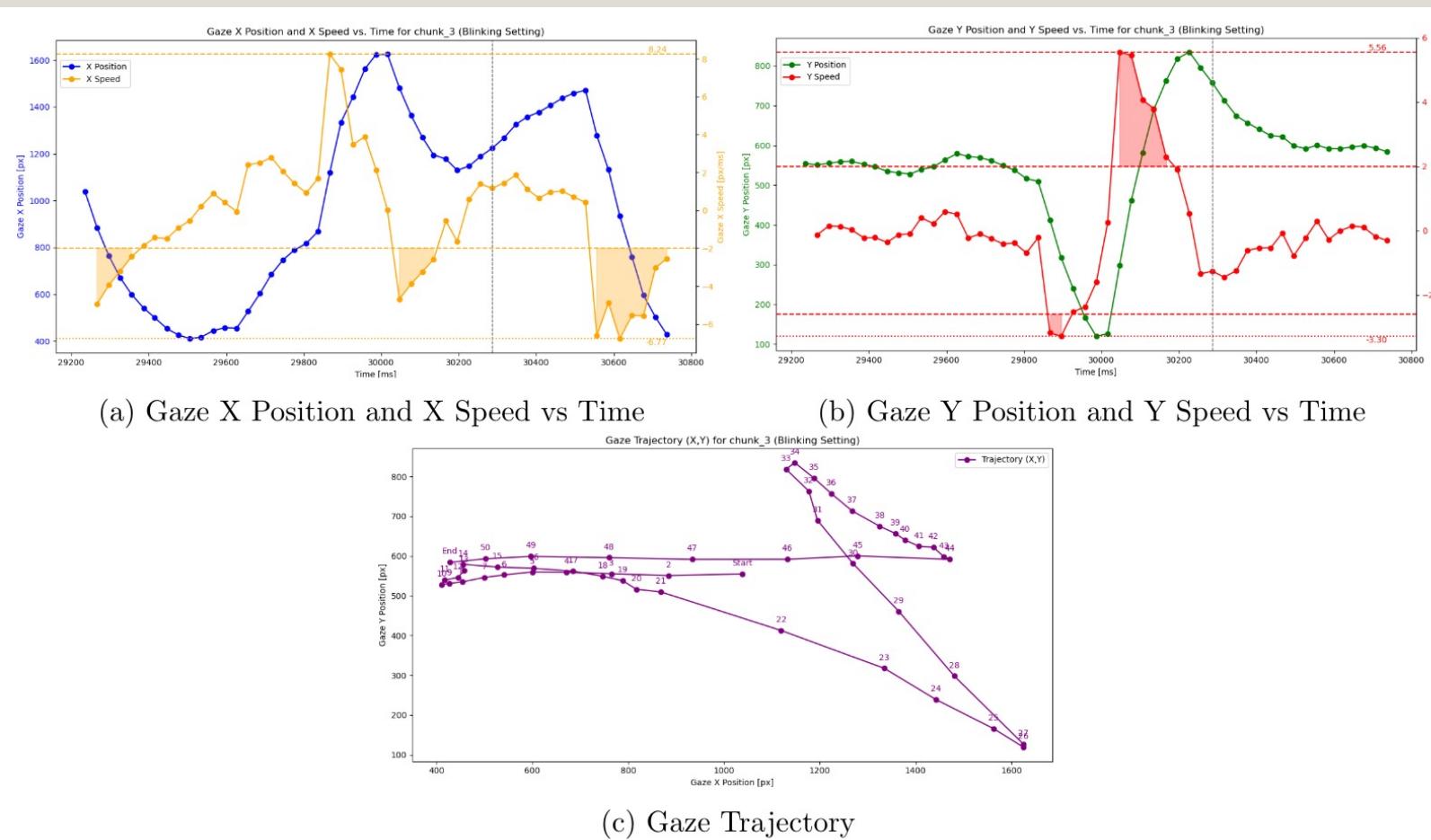


Figure 8: Chunk 3 of a text for Blinking Setting

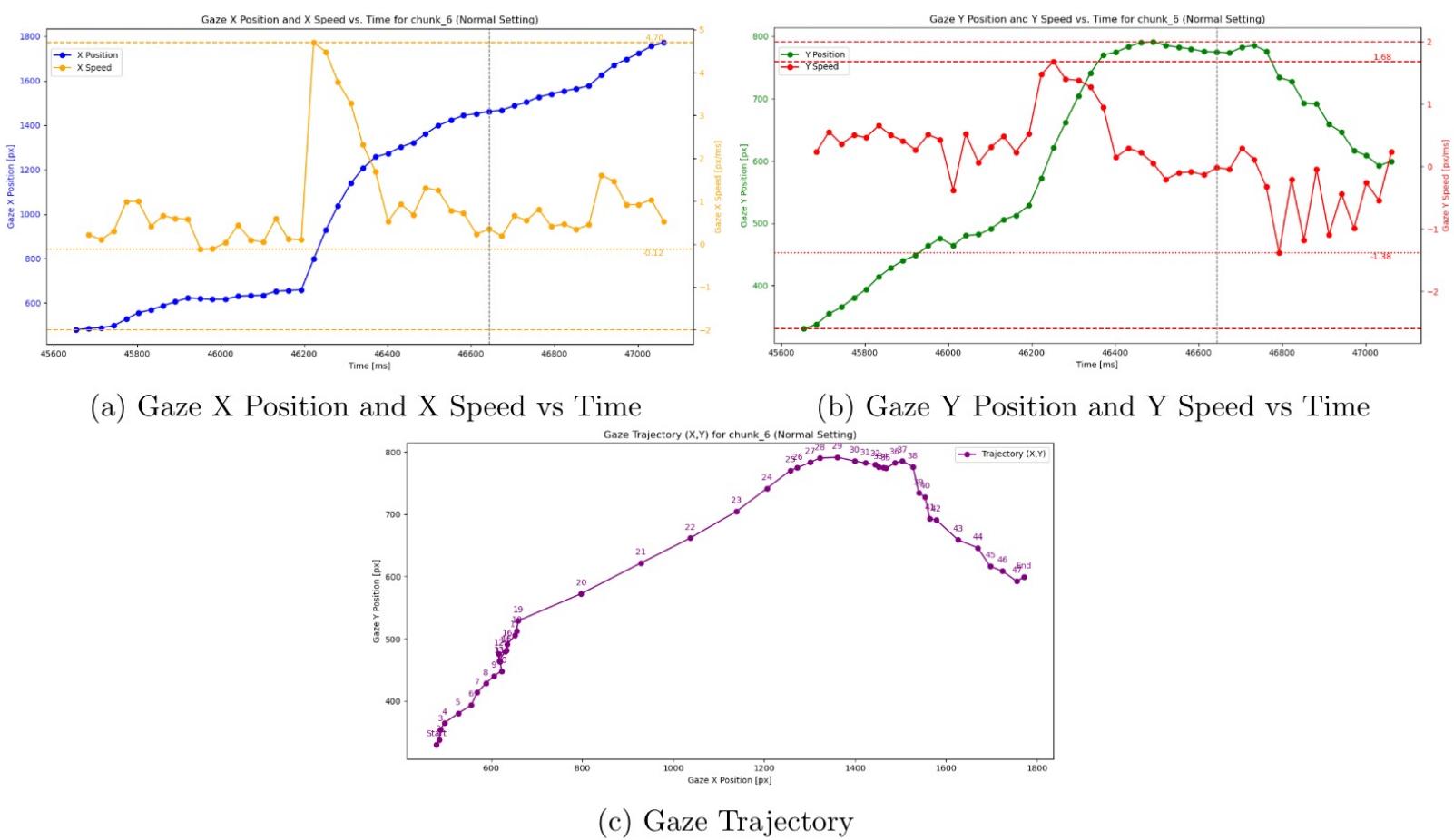
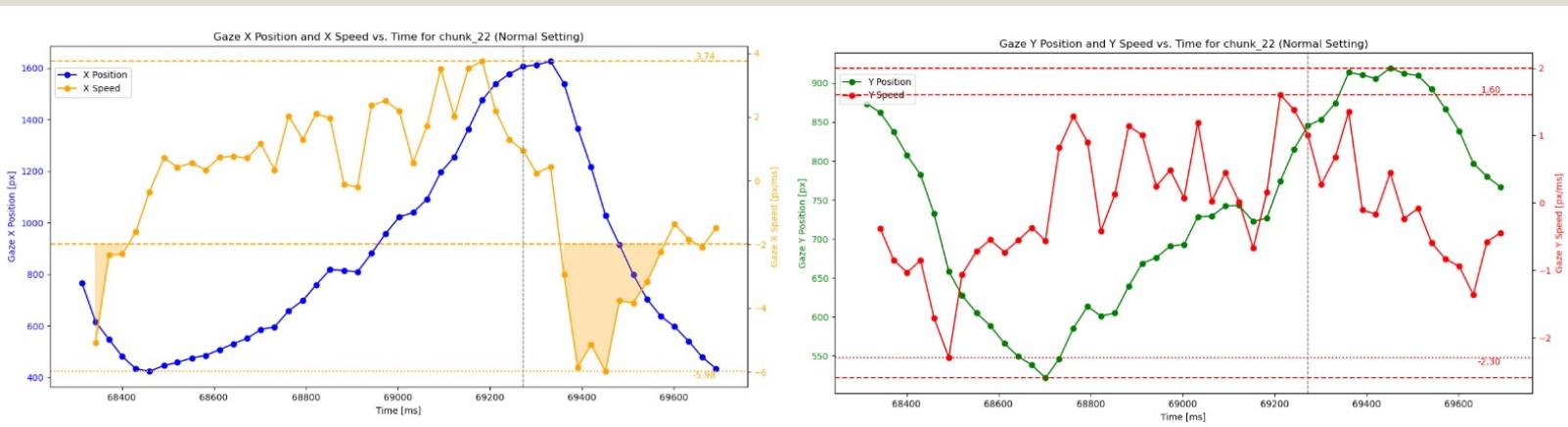
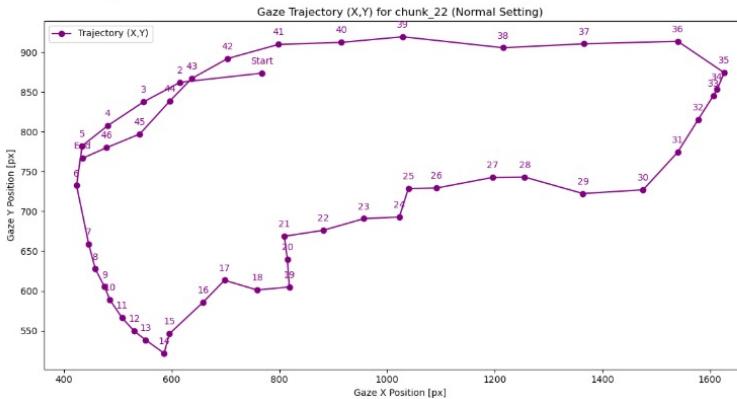


Figure 9: Chunk 6 of a text for Normal Setting



(a) Gaze X Position and X Speed vs Time

(b) Gaze Y Position and Y Speed vs Time



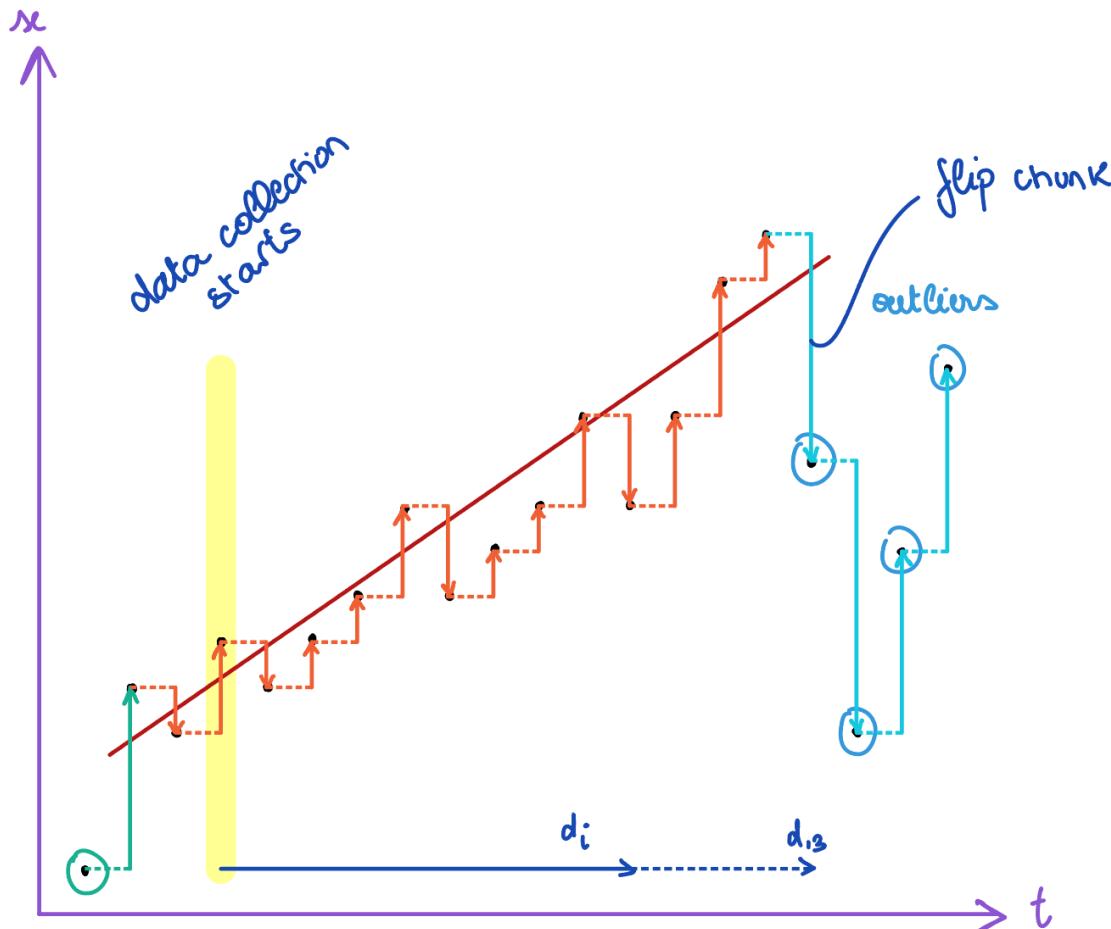
(c) Gaze Trajectory

Figure 10: Chunk 22 of a text for Normal Setting

\* assume weaggerer is accurate in se  
 $\Rightarrow d = \text{length of chunk}$

$$\rightarrow s' = \frac{d}{t'} \Rightarrow t' = \frac{d}{s'}$$

$$\rightarrow \text{WPM}' = \frac{12 \cdot \text{char Count}}{t'} \Rightarrow \boxed{\text{WPM}' = \frac{12 \cdot \text{char count} \cdot s'}{d}}$$



$$\hat{\alpha} = \frac{\sum_{i=1}^n y_i \sum_{i=1}^n x_i^2 - \sum_{i=1}^n x_i \sum_{i=1}^n x_i y_i}{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}$$

$$\hat{\beta} = \frac{n \sum_{i=1}^n x_i y_i - \sum_{i=1}^n x_i \sum_{i=1}^n y_i}{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}$$

# User Journey

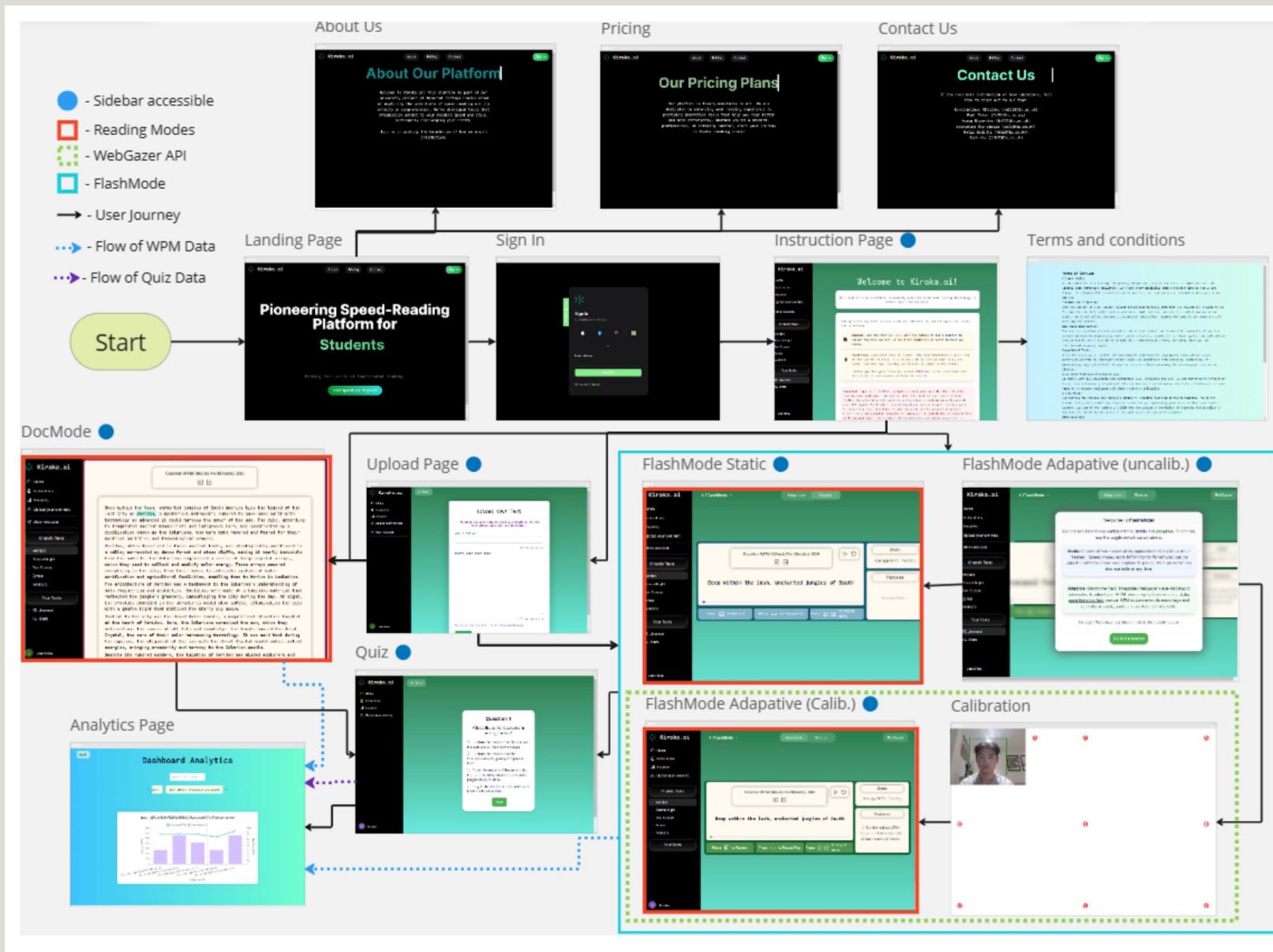


Figure 1: Snapshot of User Journey and Website Architecture