Skimming for the visually impaired

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Computer Science Senior Seminar 2020

of the speed was statistically significant (t=3.087, df=14, p=0.0040) (Figure 3). Thus, we accept **H3**.

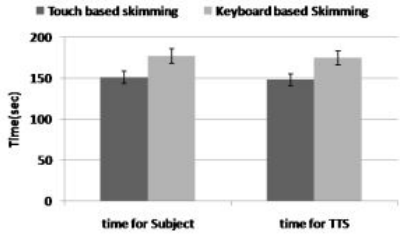

Figure 3. Average time to reach and understand the answer to a question with touch-based skimming vs. keyboard-based skimming (St. Dev.)

The Shapiro-Wilk test statistics were (W=0.80, p=0.1026) and (W=0.86, p=0.1022) respectively with the significance level of 1%, confirming the data was normally distributed. An F test did not reveal a significant difference in the variances of the two groups (F(15, 14) = 0.40, p=0.05).

Discussion: Subjects could also use dragging gesture which got them to the answer faster than if they had to skip through the summary using shortcuts.

H4: Finding information using touch-based skimming interface is easier than keyboard-based skimming.

Result: We found that, on average, people rated the difficulty of the tasks with touch-based skimming as 1.96 (St. Dev. = 0.85) and the difficulty of tasks with keyboard-based skimming as 2.46 (St. Dev. = 0.83). Using the one-tailed paired t-test, touch-based skimming was found to be significantly easier compared to keyboard-based skimming (t=3.094, df=14, p=0.0040), rejecting the null hypothesis. The Shapiro-Wilk test statistic were (W=0.80, p=0.0126) and (W=0.84, p=0.0146) respectively, significance level of 1%, confirming that the data was normally distributed. An F test did not reveal a significant difference in the variances of the two groups (F(15, 14) = 1.05, p=0.46). The medians of these two groups were both 2. A Wilcoxon Signed-rank test showed that there was a significant effect of Group (W = -43, Z = -2.17, p = 0.015).

Discussion: Subjects were more comfortable using touch-based skimming interface because it was intuitive and, unlike keyboard-based skimming, they did not have to remember the position of keys for numerous shortcuts.

p<0.0001) showed significant difference in speed. To find the answer to the question, users needed an average of 176.93 seconds (St. Dev. 45.77 seconds) and 298.8 seconds (St. Dev. = 89.21 seconds) for skimming and ad hoc navigation respectively. One tailed paired t-test (t=8.201, df=14, p<0.0001) showed that the speed difference was statistically significant. The Shapiro-Wilk test statistic were (W=0.89, p=0.0169) and (W=0.85, p=0.0155) respectively with a significance level of 1%, confirming that the data was normally distributed. An F test did not reveal a significant difference in the variances of the two groups (F(15, 14) = 3.71, p=0.01).

Discussion: Subjects were able to find the answer almost twice as fast using skimming, compared to using regular screen-reader navigation shortcuts. This result demonstrates that skimming can save screen-reader users a substantial amount of time depending on the size of the text.

Post Completion Questionnaires

At the end of the experiments, we read several statements, pertaining to variable-speed skimming to the subjects and asked them to rate the statements on a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree);Table 3 summarizes their ratings. The ratings in the questionnaires show that the majority of the subjects agreed that touch-based skimming was faster than mere touch-based navigation or keyboard-based skimming. They also expressed interest in using this technology in the future.

General Statements	Avg. (St. Dev.)
I wish I could look through articles faster than I can with a screen reader	4.60 (0.63)
I experience difficulties in fast navigation in an article with regular touch interface	4.13(0.74)
Touch based skimming made reading articles faster than regular touch navigation	4.67(0.48)
Touch based skimming is easier than keyboard based skimming	4.13(1.12)
I want to use the touch based skimming feature in the future	4.67(0.48)

Table 3. Post completion questionnaire for touch-based skimming (1=Strongly Disagree to 5=Strongly Agree)

TESTIMONIALS

Herein we provide verbatim quotes of our subjects commenting on the skimming interface:

"This is my first experience with touch. Once you are familiar with the touch interface, it's pretty easy. With the

- Skimming
  - What is skimming, why is it important?
  - Ad hoc
  - How sighted users skim
- Non-visual Skimming
  - Translating skimming strategies to non-visual formats
  - Analysis
    - Set up
    - Results
  - Generating Summaries
  - User Interface
  - Future Work

Terms

Salient: Things that stand out

Examples: Headers, bold words, bulleted lists, images

Ad hoc: when necessary

Using what you have when you need it

Skimming

What is skimming

- Skimming is a way to quickly get information from written text
- Less straining than reading
- Important for getting through lots of written material
- A common skill for sighted readers

Ad hoc, Non-visual navigation

- Screen readers and Text to speech
- Searching
- Table of contents
- Skipping

Sighted Skimming: Structures and Techniques

- Macro-structures
  - Paragraphs, tables, figures, ect.
- Micro-structures
  - Bold, Italics, colored words, lists, ect.
- Non-linear exploration
  - Goal oriented
  - Salient features
- Keyword spotting
- **Selective reading**

Non-visual skimming

Translating technique to non-visual

- Group from Stony Brook University
  - Faisal Ahmed, Yevgen Borodin, I. V. Ramakrishnan, Yury Puzis, Yevgen Borodin, Muhammad Asiful Islam
  - Have made a few different papers on Non-visual interface
- Identify qualities of a usable skimming interface

"In interviews with screen-reader users, we determined that, for

faster reading, they wanted to have access to a shortened summary

that would, however, preserve most of the original content."

Analysis

- Human made summaries
  - Each sentence
  - No paraphrasing (only words from the sentence and in the original order)
  - Informative!

Original text: nouns (31%), verbs (15%), prepositions (13%), adjectives (9%), adverbs (4%),

Summaries: nouns (54%), verbs (12%), adjectives (11%), adverbs (11%), prepositions (7%)

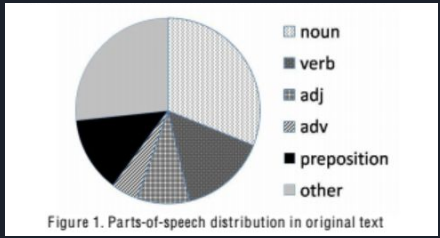

Figure 1. Parts-of-speech distribution in original text

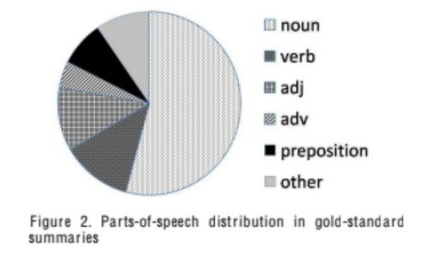

Figure 2. Parts-of-speech distribution in gold-standard summaries

Analysis

- Variations
  - “Gold Standard”
    - Includes verbs, adverbs, and adjectives
  - Nouns and Prepositions
  - Only nouns

Table 1 – Gold-Standard Summaries
A: Gold summary with nouns only:
Twitter, 10 person startup San Francisco, Obvious. Mixture networking microblogging. idea, people omnipresence. Use Iran election.
B: Gold Summary with nouns and prepositions only:
Twitter, 10 person startup San Francisco, Obvious. Mixture of networking microblogging. on idea, people omnipresence. Use in Iran election .
C: Combined gold summary
Twitter, 10 person startup San Francisco, called Obvious. Mixture of social networking microblogging. based on idea, people enjoy virtual omnipresence. Use in Iran disputed election.
D: Original paragraph
Twitter, which was created by a 10 person startup in San Francisco was called Obvious. It is a heady mixture of messaging, social networking, 'microblogging' and something called 'presence.' It's shorthand for the idea that people should enjoy an 'always on' virtual omnipresence. Twitter's rapid growth made it the object of intense interest. The object of fair amount of ridicule, as it was derided as high tech trivia or the latest in time-wasting devices. But its use in Iran in the wake of the disputed presidential election of June 2009 brought it new respect. It was used to organize protests and disseminate information in the face of a news media crackdown.

Analysis

- Set of questions to test comprehension
  - 1 question on article topic
    - “What is the article about?”-”Twitter”
  - 4 questions on nouns
    - “What is the name of the Twitter start up?” -”Obvious”
  - 3 questions on verbs
    - “What was twitter used for in Iran?”-”organize protests”
  - 1 question on numeric values
    - “How many people organized Twitter?”-”10”
  - 1 on adjectives/adverbs
    - “What kind of interest did Twitter generate?”-”Intense”

Analysis

- Comprehension and ease results

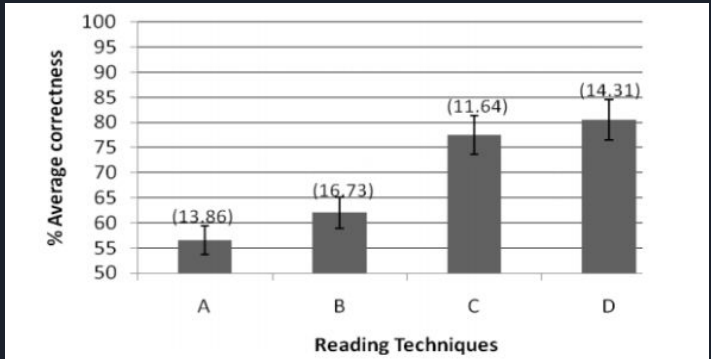

Figure 3 Average correctness (St. Dev.) of question answering with different summaries and full text D

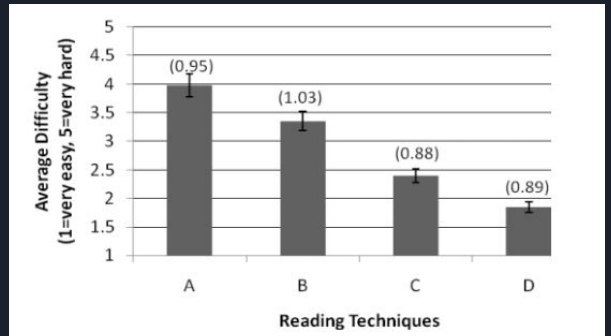

Figure 4 Average perceived difficulty (St. Dev.) of question answering with summaries and full text D

Analysis

- Now only tested with “Gold Summary”
- Had to find the answer to a question
- Switch between Full text and Summary

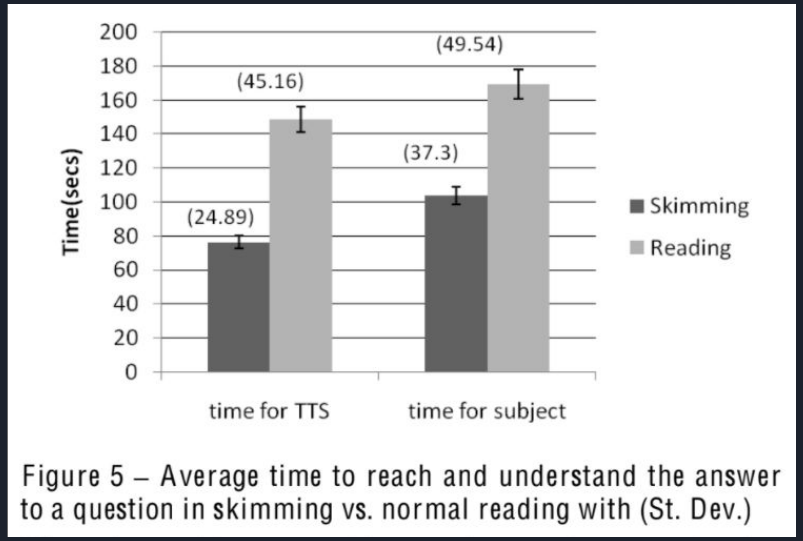

Figure 5 – Average time to reach and understand the answer to a question in skimming vs. normal reading with (St. Dev.)

Testimonials

“If I don’t know what I am looking for, this is definitely very handy. I can decide whether to read further or not.”

“I usually speed up the speech rate to read faster and use paragraph navigation. With skimming it made it easier by giving important words. But it needs more time to practice.”

“Skimming breaks up information… Introduces disorganization… There were no reference points… I don’t know where I am…”

“Skimming is faster, but important info is sometimes missing.”

Generating summaries

- Generating Typed Dependency Parses from Phrase Structure Parses
  - Marie-Catherine de Marneffe, Bill MacCartney, Christopher D. Manning
  - Stanford University

- Ways of representing the structure of sentence
  - Phrase Structure Parse: nesting of multi-word constituents
  - Dependency Parse: dependencies between individual words

Generating Summaries

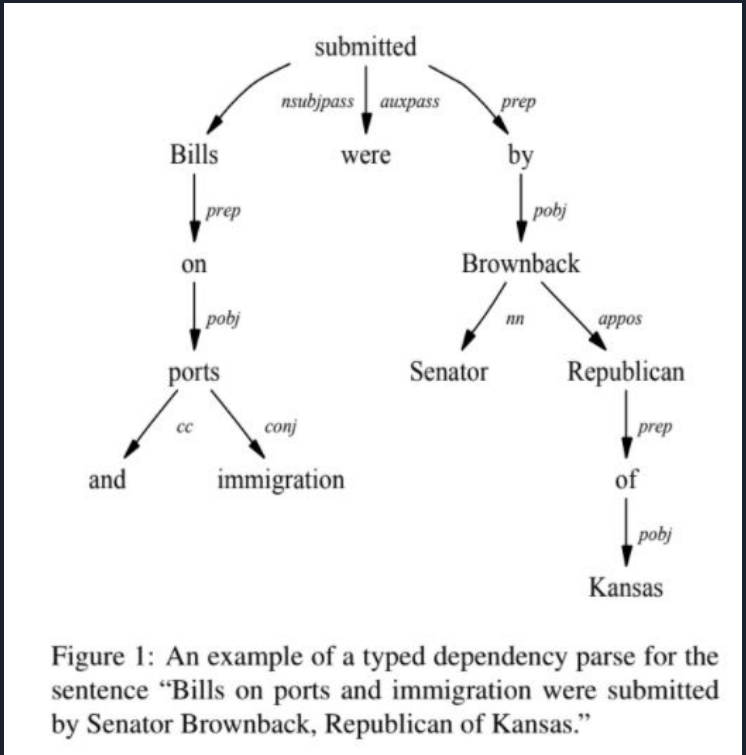

Figure 1: An example of a typed dependency parse for the sentence "Bills on ports and immigration were submitted by Senator Brownback, Republican of Kansas."

48 grammatical relations

dep - dependent
- aux - auxiliary
  - auxpass - passive auxiliary
  - cop - copula
- conj - conjunct
- cc - coordination
- arg - argument
  - subj - subject
    - nsubj - nominal subject
      - nsubjpass - passive nominal subject
    - csubj - clausal subject
  - comp - complement
    - obj - object
      - dobj - direct object
      - iobj - indirect object
      - pobj - object of preposition
    - attr - attributive
    - ccomp - clausal complement with internal subject
    - xcomp - clausal complement with external subject
    - compl - complementizer
    - mark - marker (word introducing an advcl)
    - rel - relative (word introducing a rcmod)
    - acomp - adjectival complement
  - agent - agent
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- expl - expletive (expletive *there*)
- mod - modifier

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- tmod - temporal modifier
- rcmod - relative clause modifier
- amod - adjectival modifier
- infmod - infinitival modifier
- partmod - participial modifier
- num - numeric modifier
- number - element of compound number
- appos - appositional modifier
- nn - noun compound modifier
- abbrev - abbreviation modifier
- advmod - adverbial modifier
  - neg - negation modifier
- poss - possession modifier
- possessive - possessive modifier (*'s*)
- prt - phrasal verb particle
- det - determiner
- prep - prepositional modifier

sdep - semantic dependent
- xsubj - controlling subject

Figure 2: The grammatical relation hierarchy.

Generating Summaries

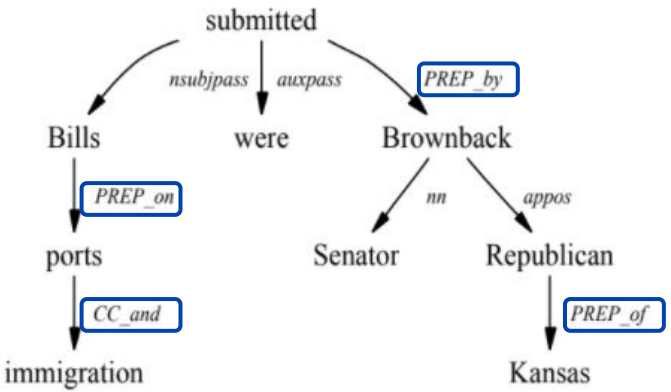

Figure 5: A dependency parse for the sentence "Bills on ports and immigration were submitted by Senator Brownback, Republican of Kansas", with "collapsing" turned on.

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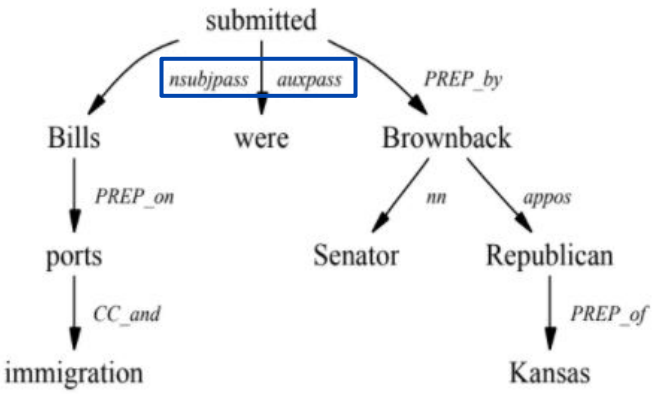

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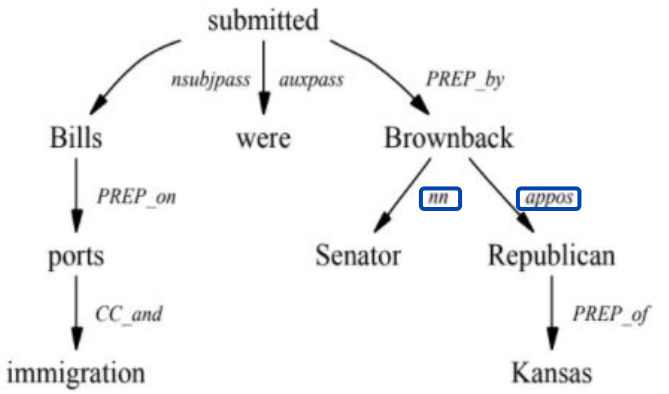

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Once the trees were determined, the researchers used a machine learning algorithms to determine the confidence score: which words are more important. The details of the algorithms are beyond the scope of my talk.

Compression

- Tree can be used to assign “confidence scores”

Original Sentence:	*"Amy is a busy student"*
Words with confidence score (SVM)	*(Amy, 1.0) (is, 0.6) (a, 0.5) (busy, 0.8) (student, 0.7)*
Sort by Confidence Score	*(Amy, 1.0) (busy, 0.75) (student, 0.5) (is, 0.25) (a, 0.0)*
Reorder by original position	*(Amy, 1.0) (is, 0.25) (a, 0.0) (busy, 0.75) (student, 0.5)*

Table 1. Annotating words: illustrative example

User interface

- Control
  - Compression
  - Speed
  - Place in text

Summary	Threshold
Afterwards, they often spray their skin with a protective coating of dust.	0.0 (original)
Afterwards, they spray their skin a protective coating dust.	0.2
Afterwards, they spray skin protective coating dust.	0.4
they spray skin coating dust.	0.6
spray skin coating.	0.8
spray.	1.0

Table 2. Variable size summaries for different threshold

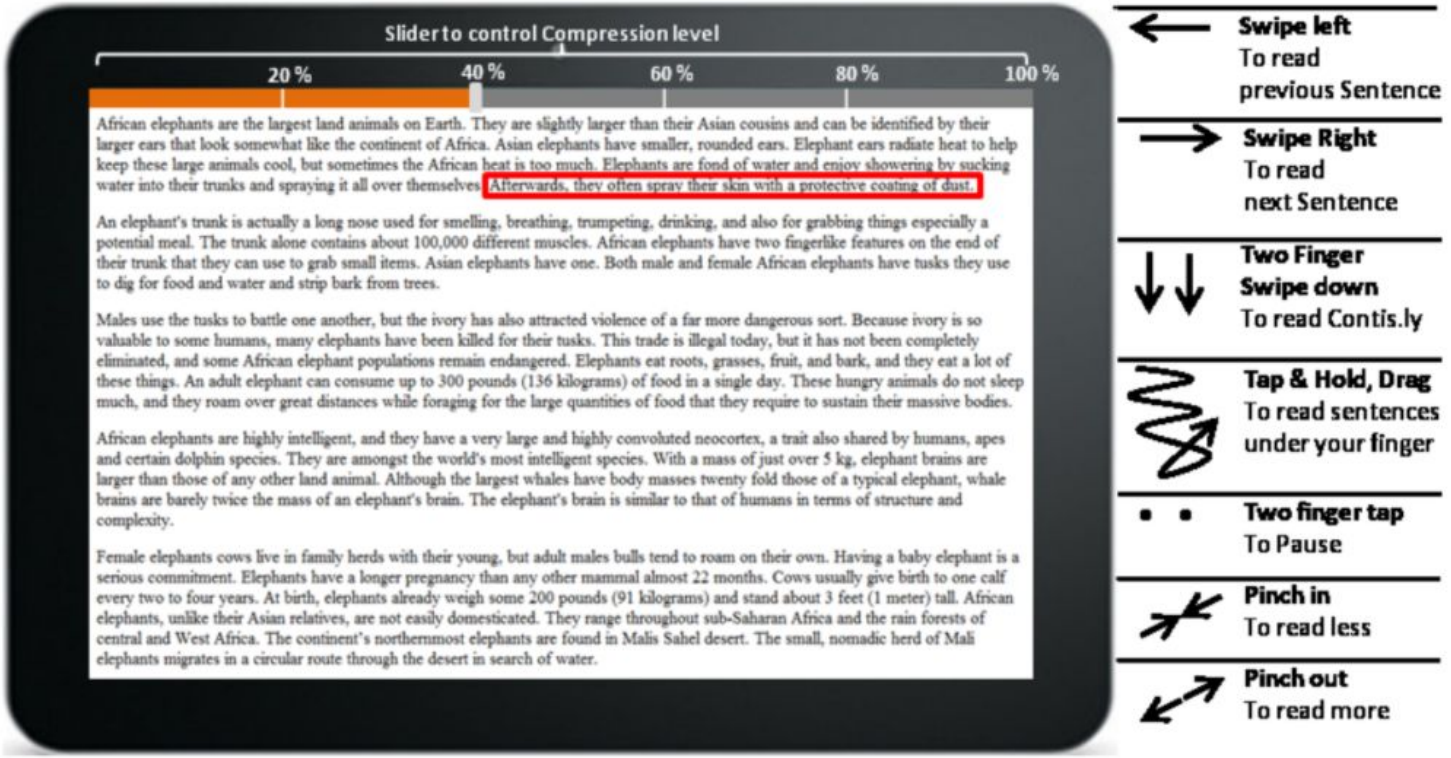

Figure 1.Touch-based skimming interface

Study

- Similar to first study from before
- Recorded time taken to reach an answer and time to understand the answer

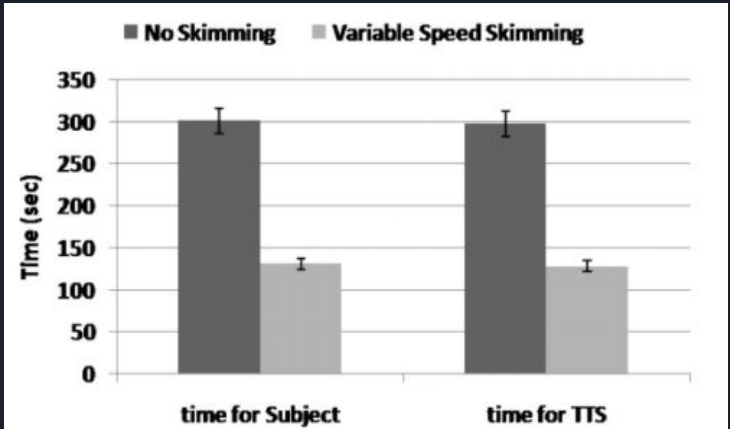

Figure 2.Average time to reach and understand the answer to a question with variable speed skimming vs. no skimming on a touch interface (St. Dev.)

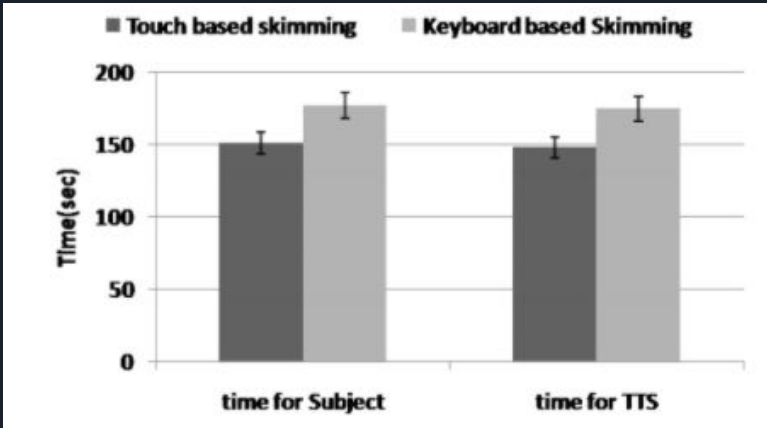

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Table 3. Post completion questionnaire for touch-based skimming (1=Strongly Disagree to 5=Strongly Agree)

Testimonials

“I like the touch command... It's faster more efficient. Touch commands are very intuitive and easier to remember. I had to put less effort to get used to them.”

“It's not for serious reading or study, but it's definitely useful to get a quick idea, when you are in short of time…”

“I like touch more than keyboard, because it's easier. I do not have to learn the command keys and shortcuts.”

“Loved the way various-speed skimming is implemented, It gives me control on how much information I need… I don’t think much practice is necessary”

Future Work

- General application
  - Web pages, summarizing page elements
- Cues for salient information
- Tactile interaction and feedback

Tactile Code Skimmer: A Tool to Help Blind Programmers Feel the Structure of Code

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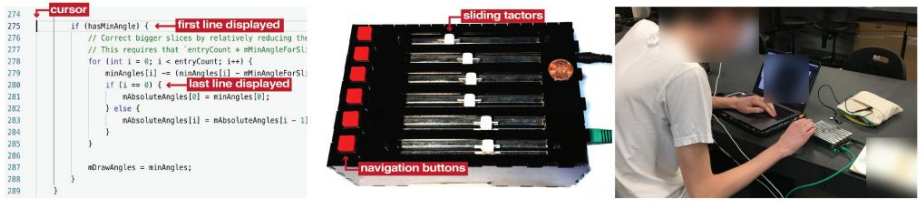

Figure 1. Indented code (left), its representation on the Tactile Code Skimmer (middle), and a participant interacting with TCS (right)

Thank You!

Thank you to Elena Machkasova, Kristin Lamberty, and peers!

Questions?

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Skim-reading Strategies in Sighted and Visually-Impaired Individuals
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June 2018
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W4A '12: Proceedings of the International Cross-Disciplinary Conference on Web Accessibility Article No.: 39 Pages 1–10
April 2012
https://doi.org/10.1145/2207016.2207052

Why Important

Accessibility

Visually impared users can enjoy the same benefits of skimming as sighted users do

With so much information coming through screens it is an important skill to be able to go through quickly

The Big Picture

-Skimming is faster than reading

-Users who cannot see well depend on text to speech things

-Text to speech is not the best for going through text quickly

-A team at Stony Brook University created interfaces for visually impared users to skim over texts