See or Hear? Exploring the Effect of Visual and Audio Hints and Gaze-assisted Task Feedback for Search Tasks in Augmented Reality

Yuchong Zhang, Adam Nowak, Yueming Xuan,
Andrzej Romanowski, Morten Fjeld
Chalmers University of Technology, Sweden; Lodz University of Technology, Poland

Media Futures

Fig. 1. Case study of visual book-searching task with the aid of AR: a): Our AR app gives a book title as search stimulus. b): Instant post-task feedback is provided by a dot smoothly following the eye trajectory; gaze playback (note: the dot is bright and highly visible in AR but is dim and difficult to see in print; here, it is located between the first and second shelves of the bookcase). c): The visual hint, as a bright purple arrow, supports the task. The timer is designed for measuring the task time (at the top of this figure). Both the gaze playback and visual hints are rendered in real world space for precise displacement. Please check our supplementary video for the demonstration of the book-searching task.

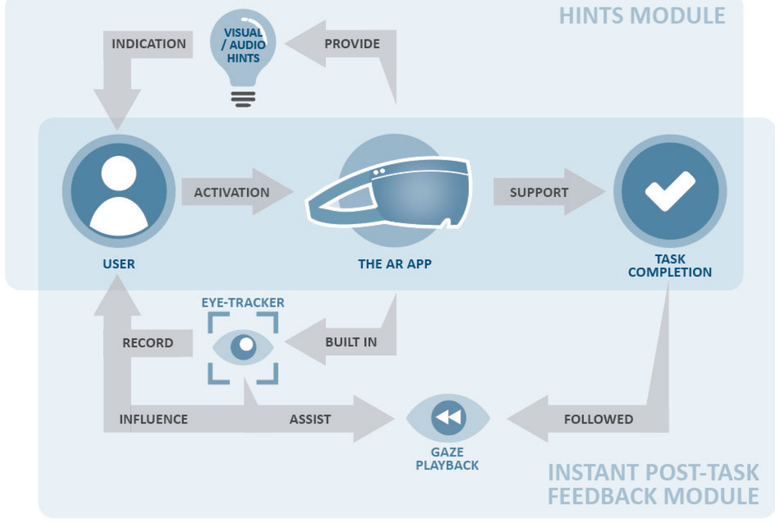

Fig. 2. Block diagram: The proposed AR approach with the two core inter-correlated modules: hints (top) and instant post-task feedback (bottom). The AR app builds on both hints and feedback (intersection).

Abstract

AR can offer clear benefits to search tasks through immersive interactions with visual cues. We propose and examine an AR approach for search tasks providing visual hints, audio hints, and gaze-assisted instant post-task feedback. The target case was a book-searching task, in which we aimed to explore the effect of the hints and the feedback with two hypotheses. H1: Both visual and audio hints can positively affect AR search tasks whilst the combination outperforms the individuals. H2: Instant post-task feedback can positively affect AR search tasks. The proof-of-concept was demonstrated by an app in HMD and a comprehensive user study (n=96) consisting of two sub-studies, Study I (n=48) and Study II (n=48). Following quantitative and qualitative analysis, our results partially verified H1 and completely verified H2, enabling us to conclude that the synthesis of visual and audio hints conditionally improves the AR search task efficiency when coupled with task feedback.

Research Contributions

1. Proposing an AR approach supporting visual and audio hints, as well as gaze-assisted instant post-task feedback for search tasks;

2. Exploring the effect of visual hints, audio hints, and combined hints on contextual AR searching;

3. Exploring the effect of instant post-task feedback in the same context.

Hypotheses

- **H1:** Both visual and audio hints have a positive effect in facilitating AR searching performance and decreasing cognitive workload in AR, while the combination of these two hints has a greater effect than either does individually.
- **H2:** Instant post-task feedback has a positive effect for task performance and cognitive workload reduction in AR search tasks.

Study Design

- We implemented a comprehensive comparative user study based on a between-subject with coupling within-subject factors.
- The independent variables were the tasks (within-subject) and the groups (between-subject).
- The study was comprised of two sub-studies (Study I and II) where the participants from Study II received the task feedback while those from Study I did not.
- The participants (n=96) were randomly sorted into four different groups in both Study I and II (n=48 in each): control, audio, visual, and the combined groups (n=12 in each). The control group received no hints.
- The two metrics (dependent variables) employed for assessing the tasks were task completion time (TCT) and NASA Task Load Index (TLX).

Fig. 3. User study: An example scene of one participant searching for a book. a): During searching; b): Book found. The two congruent bookcases are used for the two searching tasks.

Conclusion

- Both visual and audio hints have a positive effect in facilitating task performance and reducing cognitive workload in AR search tasks.
- The combination of these two hints has a greater effect than either does individually under the condition that there is instant post-task feedback.
- Instant post-task feedback has the capacity to stimulate better performance and reduce cognitive workload in AR search tasks.

PARTNERS

amedia · Bergens Tidende · fonn group · HIGHSOFT · IBM · NRK · Schibsted · 2 · VIMOND · vizrt · UiO · UiS · NORCE · WOLFTECH · Nasjonalbiblioteket

HOST

UNIVERSITY OF BERGEN

FUNDER

This research is funded by SFI MediaFutures partners and the Research Council of Norway (grant number 309339).

Forskningsrådet · sfi