

Study Overview

Criteria: low vision participants, whose vision cannot be corrected by lens or contact lens.

The purpose of this study is to design a landmark-based navigation system using augmented reality (AR) for people with low vision to help them navigate effectively indoors.

This study will begin with an initial interview to gauge a participant's experience with augmented reality and navigation. Then we will introduce our AR system to the participants, and a randomly selected route from the backup options will be used to acquaint them with the system. Participants will then have the opportunity to customize the AR system, adjusting parameters such as font and size of text and icons. The study will involve participants walking four campus routes, 2 with and 2 without our landmark augmentation AR system. Following each route, participants will be tasked with creating a mental map of the journey, providing a subjective rating (on a scale from 1 to 7) of their recollection clarity. Finally, participants will undergo an exploring interview, and their assessment of the two designs using the Likert scale will be obtained.

Research Questions:

1. How our landmark-based augmentation AR system would help participants to recall the route? - develop mental map; retrace the route
2. What can be improved in our landmark-based augmentation AR system?

Tools

Hololens 2, Unity, and Video Camera.

Data Collection

- Audio and video from the interviews, exploration session, and demonstration session will be recorded.
- Observation notes will be taken through the entire study.
- Subjective rating of how confident (from 1-7).
- The mental map drawn by the participants.
- Retrace time and correctness, as well as their behavior.
- Behavioral data from the logs.

- Subjective rating of the system about Effectiveness, Distraction, Comfort, and Usability (from 1-7)

Study Procedure

1. Read the consent form to participants, and get verbal consent (recording will be done).
Participants will be first asked if we can record the consent form process. The consent form will be read out loud for participants and they will be encouraged to ask any questions. If they consent, we will ask them to receive their verbal consent. A copy of the consent form will then be provided to them in the form of a voice recording of the form reading. They will also receive an electronic copy of the consent form through email alongside the audio-recorded copy. The electronic and audio-recorded copies will be sent after the study session has been completed.
2. Initial interview questions will be asked.
3. Introducing the AR system. Randomly choose one route from the backup routes to introduce. Record the learning time.
4. Customization.
5. Participants will be divided as 2 groups: 1 group walk the routes as with/without/with/without AR system, and the other group walk the routes as without/with/without/with AR system. The order of the four primary routes will be shuffled as the order of Latin square. So we will need $2 \times 4 \times n = 8n$ participants.

1243

2431

4312

3124

We will give the participants verbal instructions at each turn to make sure the turn-by-turn instruction will not interfere with the visual landmark augmentations. After each route, the participants will be required to draw the mental map of the routes and give a subjective rating of if they remember the route clearly (from 1-7). Then the participants will be asked to retrace the route. We will record their time to retrace, their errors/correctness, and their behavior during retrace. They may have a rest after each route.

“Please draw a map of the route we just passed. Please pay attention to the turn directions and the length of the hallway when you are drawing. (If with AR systems)

Please indicate the color of the hallway and the landmarks you passed in each segment. Landmarks that are not augmented but you used to help remember the route may also be drawn. (If without AR systems) Please indicate the landmarks that help you to remember the route in each segment. ”

Reminders: remember to take participants back to the start point from a different way!

6. Subjective rating of the system about Effectiveness, Distraction, Comfort, and Usability (from 1-7)
7. Exploring interviews.

Experiment Design

1. We have a total of 4 routes. Each route spans approximately 65 meters, featuring 2 turns and 1 additional decision point.
2. On each route we have around 4-5 landmarks (2 with 4 landmarks, 2 with 5 landmarks).
The visual/cognitive/structural landmarks are distributed as 1~2/1~2/1~2 on each route. The widths and lengths of the hallways are not counted in structural landmarks here since we augment them with color-coded hallways.

We picked the landmarks based on the following criteria:

- a. Permanent landmarks
- b. Not appearing everywhere like fire extinguishers and dustbins.
- c. Can be fitted in landmark categories we obtained from the formative study.

Evaluation of the mental map

- 1. The correctness of turns:**
The number of correct turns
- 2. The correctness of relative route segment lengths:**
Count the number of adjacent segments that have the correct relative length relationship (i.e., larger than or smaller than)
- 3. The correctness of augmented landmarks' numbers (with AR system):**
 - a. Count the percentage of correct landmarks depicted overall, as determined by an augmented reality (AR) system.

- i. Count the total number of landmarks depicted in the mental map.
- ii. Count the overall number of correct landmarks
- iii. Divide the second number by the total number.

4. The number of landmarks remembered::

Count the number of correct landmarks that participants recalled.

5. Subjective Confidence rating:

A score between 1-7 on how confident they are about the accuracy of the map.