

Repeat and speak louder

Walk after the participants

When the participant arrives

Experimenters Present: 1 lead, 1 recorder

Lead Experimenter: Hi, my name is _____. I will be leading the experiment with you today. This is _____. he/she/they will be assisting me today and recording our session. We are researchers at the HCI department at UW-Madison and our study aims to understand landmark-based navigation experience of people with low vision like you and we have designed an assistive augmented reality system to help that we would like you to test today.

Camera attention:

- Follow the participants
- Focus on the foot during the experiment
- Use phone to audio

Tutorial Location: ____ 4th Floor ____

Read the Consent

Before we get started, I will read the consent form to you.

You are invited to participate in a research study about how we can help visually impaired people navigate indoor environments. The purpose of this study is to explore how people with low vision navigate indoors and how our landmark-based navigation system can enable people with low vision to effectively navigate and develop a better mental model of the environment.

You will be audio and video recorded during your participation in this research. Audio and video recordings in their original form will only be seen by the research team. Anonymized images or videos may be included in publications, academic presentations, and classrooms. The recordings will be retained indefinitely to be used in future research.

The study involves an initial interview, a tutorial session to let you get familiar with our system and a navigation session where you will navigate several routes in the building

while wearing or not wearing an augmented reality device. Lastly, a few exit interview questions will be asked. The study will last no more than two hours.

Your participation is voluntary and you can stop or take a break at any time. We will make sure that the study length does not exceed the maximum length stated above and will provide you with the opportunity to take breaks if needed. Please inform the experimenter if you feel fatigued or frustrated and would like to take a break. You can take as many breaks as you would like.

Protected health information is information about your physical or mental health that includes your name or other information that can identify you, like your date of birth or medical record number. To do this study, we will use the following kinds of information:

1. For those with low vision, information on your vision condition may have been accessed from your medical record to confirm you were eligible to participate in this study.
2. Things you tell the researchers about your health.

You will receive compensation for participating at the rate of \$20/hour and will be compensated up to \$30 of commute fees.

Now we would like to have your oral consent for the study. Would it be ok if we record the process?

1. What is your name and what is that date for today?
2. Do you agree to participate in this study?
3. Do you agree to be quoted directly in publications without your name?
4. Do you give authorization for your protected health information to be used and shared as described in this form?

Initial Interview Questions

Now, I have a few questions for you:

1. What is your name?
2. What is your age?
3. What gender do you identify with?
4. What is your Visual condition?
 - a. Are you considered Legally blind?
 - b. What is your Diagnosis?
 - c. What is your Visual acuity?
 - d. What is your Field of view?
 - e. What is your Contrast sensitivity?
 - f. What is your Color vision?

- g. What is your Light sensitivity?
- h. What is your Depth perception?
- 5. How long have you had this visual condition?
 - a. Is this condition progressive or stable?
- 6. Do you use any technology to navigate regularly (indoors)?
 - a. If yes, what technology do you use?
- 7. Do you pay attention to any landmarks during navigation? What landmarks?
- 8. Do you use any technology to help you perceive the landmarks?
- 9. Do you have any prior experience with Augmented Reality (Google glasses, phone application, hololens)?
 - a. If yes, could you please share the experience?
- 10. Are you currently familiar with navigating inside the Engineering Building?

Tutorial: Do not feel like reading

Now I will give you a tutorial to use the system.

Please wear the augmented reality headset. Here is the device, here is the display. There is a node by the back, you can rotate it to adjust the size, then you can put it on your head. Would you mind if I help you in putting on the AR headset?

Repeat and make sure they understand

Double check, can you describe what you see now

Now I will show you our system. It will augment some features of the hallways and some potential landmarks to help you remember the environment.

Signboards: Can you see the arrows ahead? Could you please describe what you see? There are 3 arrows there, right? These arrows indicate possible directions you can take. We call these signboards. You will see them every time there is an intersection coming up. The length of the arrows is relative to the length of the hallways, while the width of the arrows is relative to the width of the hallways. And can you see a line at the end of the right arrow? That means the path on your right hand side will lead to a deadend.

- Do you think the arrows will be helpful? Why?
 - What do you think of arrows illustrating the routes?
 - What do you think of using the arrow lengths and widths to provide an overview of the hallway? Why?
 - What do you think of the idea of marking a deadend in the current way? Why?

Color hallways: Have you noticed that the arrows have different colors? Could you please describe what you see? We use color-coding to distinguish between different hallways, which match the color of the corresponding arrows on the signboard. For example, the red hallway ahead has the same blue color in the upward arrow on the signboard.

- Are these colors distinct enough for you? Any suggestions for colors?
- What do you think of the idea of color-coding the hallways? Why?

Icons on the signboard: Now can you see the icons and texts close to the arrows? Could you please describe what you see? These icons and texts represent the landmarks you'll encounter in the upcoming hallways. For example, there is a AED in the hallway on your right hand side. The positions of the icons on the arrows indicate the relative positions of the landmarks in the hallway. For example, if you walk on the hallway ahead, you will encounter a restroom first, followed by a elevator.

- Are these icons visible to you?
- How helpful do you think of using icons on the signboard to give you an overview of the landmarks on the later routes?
- How helpful do you think the text is? Why?

Icons in-situ: Now can you see the icons and text markers along the path? Could you please describe what you see? For example, you might see an elevator icon ahead, indicating the presence of an elevator. These icons and texts are positioned at landmark locations and correspond to the icons displayed on the signboards. They will provide clear guidance along the way.

- What do you think of using these in-situ icons to highlight the landmarks?
- How helpful do you think the text is? Why?

We also designed different icons to represent different types of landmarks. Now I would like to introduce you to the five different landmarks and their icons, one by one.

A. The first icon you see is for visual landmarks. You'll encounter this icon whenever you pass a visually obvious landmark that draws your attention. For example, we consider the blue wall or a red cork board as visual landmarks.

B. The next icon represents information landmarks. You will see this icon every time you pass landmarks such as the restroom or a lab. These landmarks will provide you with some kind of information.

C. The icon you see now is for accessibility landmarks. You'll come across this icon near landmarks like elevators, ramps, and railings; this kind of landmarks can facilitate accessibility.

D. The following icon represents emergency landmarks. These landmarks indicate potential dangers or emergency resources, such as biohazard labs or AED locations.

E. Finally, the last icon represents structural landmarks. You'll see this icon near structural elements like doors or windows. They mark the building's architectural features.

- What do you think of the design of the icons? Are they understandable enough?

Customization: Now you can customize the system a little bit.

First of all, do you want the size of the signboard to be larger or smaller?

Do you want the size of the icons on the signboards to be larger or smaller?

Do you want the font color of the texts on the signboards to be changed? Now they are green.

Next, do you want to enlarge or reduce the size of texts on the path?

(With all augmentations on) Now you may walk around on our tutorial path to explore our system. Do you have any questions?

Take a short break....

Instructions overall

We're about to begin our navigation session. During this task, we'll walk four different routes within this building. You may be instructed to wear or not wear the headset for each route. Following each route, you'll be asked to draw a map of the path you walked and then retrace it. Now, let's proceed with our first route.

Counterbalance 2 (with vs. without AR) x 2 (3rd floor vs. basement)

Instructions for Without AR

(Now we are gonna to explore another route.) For this task we will be walking on a specific route in this building without wearing an AR headset. We will assign you a destination, and also provide verbal instructions about turning directions whenever you reach an intersection, until you reach the destination. During the navigation, you can feel free to look around and observe the environment, and walk with a speed that you

feel comfortable with. After completing the walk, you will be asked to draw a map of the route you walked on as well as any landmarks or objects you remembered along the route, as accurately as possible. We will then ask you to come back to the start point and navigate to the destination by yourself as quickly and accurately as possible.

Do you have any questions about that?
If yes, explain the task again.

If not, start.

Instructions for With AR

(Now we are gonna to explore another route.) For this task we will be walking on a specific route in this building and you will be wearing AR glasses. With the AR glasses you will see all the design augmentations like colored hallways, signboards and landmark icons and texts as you saw in the tutorial. We will assign you a destination, and also provide verbal instructions about turning directions whenever you reach an intersection, until you reach the destination. During the navigation, you can feel free to look around and observe the environment, and walk with a speed that you feel comfortable with. After completing the walk, you will be asked to draw a map of the route you walked on as well as any landmarks or objects you remembered along the route, as accurately as possible. We will then ask you to come back to the start point and navigate to the destination by yourself as quickly and accurately as possible.

Do you have any questions about that?
If yes, explain the task again.

If not, start. **Can you describe what you see now?**

Map Drawing Instructions

Now please take off the device. We will need you to draw a map of the route we just navigated, and any landmarks or objects you remembered along the route, as accurately as possible.

After drawing: How confident are you about the accuracy of the map? Could you please offer a score between 1 and 7, with 1 stands for least confident and 7 means most confident?

Remember to take participants back to the start point from a different way!

Retrace Instructions

Now let's go back to the starting point and retrace the route. However, we will take a different way to go back to the starting point, so you don't need to try to memorize our way back to the starting point.

Now we are going to retrace the route that we just navigated. I will **not** give you verbal directions to turn this time and please walk as fast as possible to the destination. The start point is here, marked by rubberized fabric, and the endpoint is similarly marked. When you believe we've reached the endpoint, please announce 'Done' loudly as soon as you believe you arrive at the destination.

Do you have any questions about that?
If yes, explain the task again.

If not, Let's begin.

Take a break...

Exit Questions

Congratulations and thank you very much! We have finished all the navigation tasks. Now we have some exit questions for you before we finish the study to reflect on your experiences with our system and design.

1. Let's first talk about your landmark choices in the four trials. (Based on the mental map) Why do you pick a specific landmark? (without the AR system)
2. Our systems select and augment certain types of landmarks for you. Do you think they are useful or not? Why? What landmarks do you prefer to be augmented in indoor navigation?

You've experienced our system that includes several components of augmentations in the environment. Let's go through them one by one and talk about your experience.

3. Let's start with the signboard. For [each element], how do you like it? How does this design affect your understanding of the route? How do you want to improve it?

- a. The presentation of the structure of the hallways (e.g., direction, width, length, color-coding)
 - b. The presentation of deadend
 - c. The icons and texts of the landmarks on the signboard
4. In-situ elements - The color coding hallway; in-situ icons & text
5. Effectiveness: How effective do you think of the system? Could you please offer a score between 1 and 7, with 1 stands for least effective and 7 means most effective?
6. Comfortable: How comfortable do you think of the system? Could you please offer a score between 1 and 7, with 1 stands for least comfortable and 7 means most comfortable?
7. Distraction/Load: How distracting do you think of the system? Could you please offer a score between 1 and 7, with 1 stands for least distracting and 7 means most distracting ?
8. Learnability: How easy to understand or learn do you think of the system? Could you please offer a score between 1 and 7, with 1 stands for least easy to use and 7 means most easy to use?
9. Any ideas for other designs of augmentation (brainstorm) to support your indoor navigation and mental model development?