



## Research Questions

1. What special requirements and wishes do users have for indoor navigation applications?
2. Is it possible to standardize application settings for people with visual impairments and blindness keeping in mind that each individual has their own idiosyncratic way of dealing with their disability?

## Theoretical Background

Globally, an estimated 2.2 billion people have a visual impairment or blindness [1]. Loss of vision affects people of all ages and can occur at any time, yet most people with impaired vision are over the age of 50. With an aging general population [2], the number of people with impaired sight will likely rise and their requirements should be addressed.

As one substantial component of self-determined life is independent and safe locomotion, smartphone navigation contributes to the idea of inclusion and improves quality of life [3].

Navigation via GPS outside of buildings poses problems for many visually impaired people (ViP) and indoor-navigation is generally unavailable [4].

While studies often focus on testing the navigation system itself (e.g. [5]), interviewing blind people and ViP prior to development is less common. Although dedicated navigation applications have been available and in use for several years. However, users can thus provide important and useful information about the advantages and disadvantages of these applications.

## Research Project DYNAMIK

Project DYNAMIK focuses on developing an indoor navigation system, taking into account the needs of people with different impairments.

For the necessary precision in indoor localization, the project will use ultrawideband-sensors. One goal of the project is to make results and insights available to a broader public by using Open Source. The application is developed with Flutter, a cross-platform programming framework based on Dart, while data for the cartography will be exchanged with the OpenStreetMap Community.



## Method

### Online questionnaire

- Categories: demographic data, technical affinity, daily smartphone use, accessibility tools on the smartphone, navigation and – applications
- 45 questions (yes/no, multiple choice, semi open-ended questions)
- N = 29 (n = 19 blindness, n = 3 high-grade visual impairment, n = 3 significant visual impairment, n = 1 visual impairment; thereof 4 with other physical impairments)
- Age: M = 42.0 , SD = 14.73 (m = 12, f = 15, mi\* = 1) \*missing information

### Interviews

- guideline-based interview
- 29 fixed questions for each participant (e.g. What information do you want to know in advance before entering an unfamiliar building? Does this number of steps affect whether you decide to use the stairs or the elevator?)
- Via telephone and/or video call
- N = 10 (blindness or high-grade visual impairment)

## Results \*

### Navigation

Use of guide stick and guide dog: N = 19

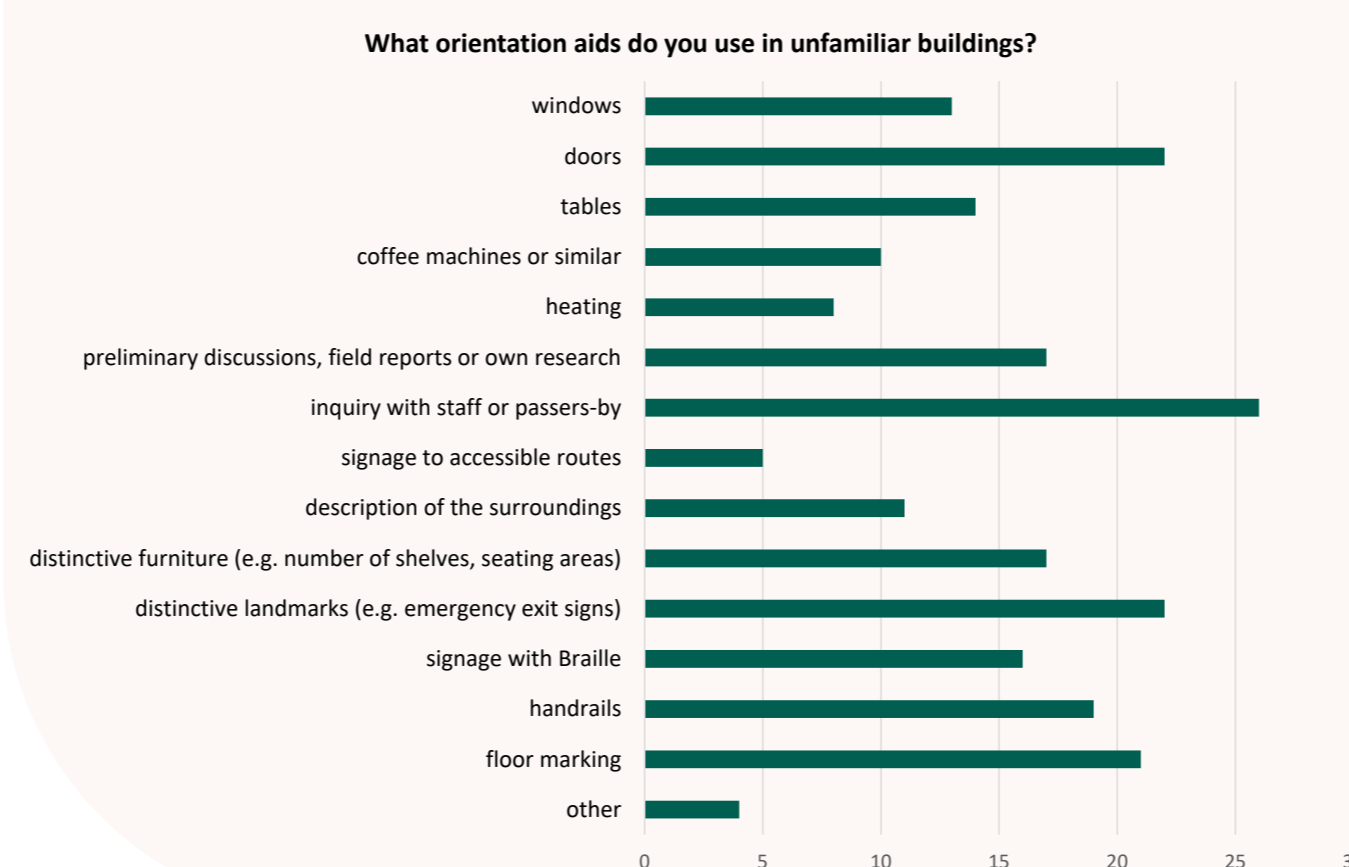
Avoidance of unknown places: yes = 16, no = 12, mi = 1

Why?: "there I can not orient myself"; "Don't know the way, don't recognize obstacles, fear to get lost"; "Afraid of getting lost and of unforeseen obstacles."

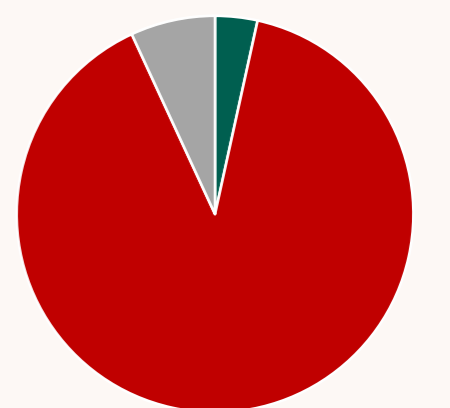
Use of navigation application on smartphone: yes = 19, no = 7, mi = 3

### Indoor Navigation

What obstacles make it difficult for you to navigate and move around buildings? (N = 18)  
e.g. change of flooring, missing floor structure, obstacles, open or half open doors, large open spaces, standee, pedestals



### Use of the smartphone inside buildings



■ yes ■ no ■ missing information

### Interviews

If you could choose one building to integrate our navigation app, which one should it be?

- Train station
- Library
- Airports
- Citizen offices
- Public institution
- Cinema

What information do you want to know in advance before entering an unfamiliar building?

- Accessibility (1)
- Stairs/ Handrails (3)
- Elevator (3)
- Structure of the building (10)
- Other (e.g. documents) (8)

\*If you want to get all the results and more information, please contact the authors.

## Discussion

1. Smartphone use is common among blind people (support in daily life), basis for indoor navigation app is given.
2. Special requirements: extensive prior information, dynamic obstacles in the building complicate the navigation in the building.
3. Partial standardization possible: obstacles & landmarks relevant for all (e.g. handrails, floor condition, door opening); wide variations due to socialization & history of each person (reading braille, counting steps)
4. Covid problems: target group ViP is even more excluded & difficult to reach; remote research is problematic (technical problems, high dropout rate)

## Future Research

1. Unexpected issue: Research fatigue and lost trust in scientific research among people with disabilities
2. Workshops, experimental research for continuous project development
3. Expansion to english speaking foreign countries
4. Integrated tracking of dynamic obstacles for indoor navigation purposes

## References

- [1] Vision impairment and blindness. (2021, February 26). World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment>
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- [3] Albrecht, G. L., & Devlieger, P. J. (1999). The disability paradox: high quality of life against all odds. *Social science & medicine*, 48(8), 977-988. [https://doi.org/10.1016/S0277-9536\(98\)00411-0](https://doi.org/10.1016/S0277-9536(98)00411-0)
- [4] Williams, M. A., Hurst, A., & Kane, S. K. (2013). "Pray before you step out" describing personal and situational blind navigation behaviors. In *Proceedings of the 15th International ACM SIGACCESS Conference on Computers and Accessibility*, 1-8. <http://dx.doi.org/10.1145/2513383.2513449>
- [5] Guerreiro, J., Ohn-Bar, E., Ahmetovic, D., Kitani, K., & Asakawa, C. (2018). How Context and User Behavior Affect Indoor Navigation Assistance for Blind People. *Proceedings of the 15th International Web for All Conference*, 1-4. <https://doi.org/10.1145/3192714.3192829>