Towards Identifying and Classifying Navigation Strategies Among Individuals with Diverse Disabilities

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Abstract. In this paper, we describe a study examining navigation practices of individuals with disabilities—including people with visual, mobility, and cognitive disabilities, as well as older adults—towards identifying and classifying the common features they utilize in unfamiliar environments. Analysis of initial data reveals previously-undocumented commonalities and departures amongst users from different populations. For example, we found that natural light sources are an important navigation cues for not only blind and low vision individuals, but also for older adults and mobility-impaired individuals. This suggests novel design features for assistive apps to better support navigating indoors in absence of windows. Our work aims to inform design of more universally-usable navigation solutions that address collective needs of a wide range of users.

Keywords. Navigation, Older Adults, Orientation, Physical Disabilities, Visual Disabilities.

1 Introduction

The ability to orient position and navigate successfully are skills which are often taken for granted. However, in unfamiliar environments, particularly indoor venues, challenges when orienting one's position and navigating can be faced by a range of users, particularly those with disabilities. A unique and further set of hurdles are encountered by individuals with disabilities if the building or structure does not comply with standards denoted in the Americans with Disabilities Act. Currently, the majority of studies examining navigation solutions for disabled users focus on ways to better match designs to the needs of the blind community (e.g., [1-3]). While these navigational solutions are valuable, less consideration has been given to the needs of other groups who may also benefit from support with the process of orientation and navigation, as well as the intersections of the needs of these groups. Furthermore, solutions have often focused on outdoor navigation, rather than issues which may be faced within indoor venues where users may want to visit (e.g., hospitals and medical offices, federal/state buildings, shopping malls, banks etc.). Our research aims to identify factors to aid with the process of orientating position and navigation, and examine the common factors which different groups use to navigate. Although our focus is mainly on indoor environments, we are also interested in transitions between indoor and outdoor venues, so we have questioned users on both aspects. Findings can be applied to the design of a universally-usable solution, rather than a solution focused on matching the needs of one group.

In this paper, we describe the design of a study to investigate the ways in which individuals with a wide range of abilities orient and navigate within unfamiliar environments. More specifically, we have focused on three communities: individuals with visual impairments (including individuals who classify themselves as fully blind or low vision), individuals with physical disabilities or those who identify conditions which impact mobility, and older adults (aged 60 and over). We have aimed to explore the needs of users from all ends of the spectrum, ranging from those who navigate independently to those who rely on others for support. Similarly, we are also focusing on those who rely on newer methods of technology and those who favor tried and trusted methods. The study is currently in progress, so only a subset of findings are reported in this paper. Early findings from our work offer an interesting perspective on the ways in which certain features, if integrated with the design of a navigational tool, can be used to support multiple communities.

2 Related Work

The need for assistance in the processes of orientation and navigation has been well documented by researchers [1-7]. Many of these studies focus on supporting people with visual impairments [1-5], informed in part using techniques inspired by those learned in orientation and mobility (O&M) training [4]. Examples include using auditory cues from the environment, landmarks, and elements of the environment to reorient themselves, etc. [5]. Research has shown that those who are visually impaired rely on landmarks to navigate, (e.g. position of buildings, changes in the texture of the terrain) [4,6]. Studies have also found that some individuals with visual impairments rely on sighted guides or auditory cues for obstacle avoidance [3,4,7], due to the unpredictable nature of obstacles which may block routes.

The majority of technologies developed have focused on outdoor navigation, often using GPS. Although indoor navigation devices such as the NavCog3 [3], OurWay [8], and VizMap [9] are in development, these are not widely available to the public. OurWay focuses on the accessibility of people with physical impairments [8], whereas the others mentioned, and most other devices, focus on those with visual impairments. Furthermore, research shows that users with visual impairments have to use multiple applications for different aspects of the navigation [4] which can pose challenges when attempting to navigate in a hurry or when distracted. However, key insights can be gleaned from these papers about proposed indoor navigation devices in order to aid in our research. For example, Montague suggests that an indoor navigation system should be customizable as to fulfill the needs of users with a range of abilities [10], while Cassidy proposes that such a system should focus on providing cues (e.g. location of bathroom, location of vending machines) to aid in orientation, rather than provide turn-by-turn directions [11]. Along the same lines, VizMap utilizes computer vision and crowdsourcing to collect information about an indoor environment (e.g. signage, exits) and makes it available non-visually [9].

Using a human-centered approach, our research aims to better understand the needs of multiple groups of users with disabilities, with the long term goal of identifying themes which can be used to support the design of universally usable navigational tools.

3 Method

Semi-structured interviews were selected as a method of gathering data. Questions were based upon findings from initial conversations with individuals recruited, through personal and professional networks, who self-identified as older adults (i.e., aged 60 and over), having visual impairments, and/or having physical impairments. Interview questions were divided into thematic sections, including: experiences in planning routes, route preferences, navigating indoor and outdoor environments, and the participant's trust in their own orientation and navigational abilities and the current technologies they utilize. The remainder of recruitment was conducted with assistance from professional organizations and snowballing from participants. Interviews lasted for 60-90 minutes in total, and were transcribed in their entirety. Transcripts were reviewed and coded independently by members of our research team. Themes were then discussed.

In this paper, we report a subset of early findings from eleven participants, including: one individual with a visual impairment (B1), two older adults with visual impairments (OB1, OB2), three participants with mobility impairments (M1, M2, M3), one older adult with a mobility impairment (OM1), one older adult with a cognitive disability (OC1), and three older adults (O1, O2, O3) who do not identify as having any of the above impairments.

4 Common Themes Identified & Current Project Status

Three high level themes were identified from the subset of the data analyzed.

Obstacle Avoidance: Six participants described physical obstacles (e.g. chairs, other fixtures or furniture, pedestrians both in motion and those who may stop mid-route, cordoned off areas where repairs may be taking place (OB1, M3, OM1)) impeding their ability to navigate successfully within an indoor environment. As the position of these obstacles could vary considerably, vigilance would need to be maintained to ensure that, if encountered, participants would be able to side-step or find an alternative accessible route. The latter was found to be more challenging, as, depending on the environment, there may be few alternatives available. Pre-steps may be needed (i.e. planning routes prior to getting to the destination) just to be able to feel confident when navigating. Others (OB1 and OB2) indicated that they would like their personal navigation tool, be it a companion or technological device, to alert them when an unexpected obstacle appears.

Searching for cues to determine position: Four participants (B1, OB1, OB2, and O3) highlighted a reliance on using physical landmarks (e.g. position of distinctive buildings, large features within a building, a change in level of light perceived) as a method of orienting themselves. To offer more perspective on different uses of these cues, B1 and OB1 described using sunlight to determine shifts in locations, while M1 and M3 highlighted the use of sunlight to help locate the position of windows and doors. In contrast, OB2 and O2 described using sunlight to determine direction. OB2, OM1, M3, O1, O2, and O3 indicated that they use signage as a tool to orient themselves in unfamiliar locations. However, the quality and utility of signage was thought to vary considerably from environment to environment. OM1 and M3 further expect signage to indicate accessible paths. However, presence of accessible routes could not be taken for granted in all indoor environments.

Inhospitable conditions: Three participants (OM1, M3, and OB1) described the impact of inclement weather on navigation when moving from outdoor to indoor environments. Examples include: plowed snow blocking curb cuts, thereby creating a barrier to access (OM1 and M3). O2 and OB1, both of whom have hearing impairments and use hearing aids, avoid paths with overwhelming noise (e.g. from traffic, construction, indoor environments with loud music blaring) as it disrupts their ability to hear other signals. B1, OB1, and O3 described avoiding paths that are dimly lit because the lack of light impedes their navigation ability. This may encourage them to modify their behavior by planning journeys at times when light would be present, rather than at times that would be convenient.

The themes identified offer a perspective on the factors which individuals with disabilities take into account when navigating and orienting position. Our findings suggest that there are common themes gathered from individuals with different disabilities, although the reasons behind using specific strategies may vary. We surmise that by providing further customization within navigational tools (e.g. mobile apps) which allow specific features to be presented (e.g. specific landmarks, presence of specific obstacles etc.), it would aid multiple groups of users.

Interviews are currently ongoing. We aim to develop a set of persona-like profiles that encompass the shared and distinct navigation needs of people with diverse disabilities. We anticipate these findings will support design of future technologies that are more useful and inclusive navigation aids.

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