Towards Effective Human-Robot Interaction for Visually Impaired Adults

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***Abstract*—When assisting humans, robots may need to employ a variety of interaction modalities including physical, aural, visual, and remote (through intermediary devices and interfaces) strategies. While assistive robots and their interactions with humans have been studied in a variety of contexts , the literature on robots interacting effectively with people who are visually impaired is limited to dog-guide style robots [1] and robotic shopping carts [2]. In this work we explore the foundations of human-robot interaction for visually impaired adults in the context of robots assisting people with urban navigation tasks.**

I. Introduction

The World Health Organization (WHO) estimates that 285 million people in the world are visually impaired, of whom 39 million are blind. Although safety, efficiency, and independence are critical factors in urban navigation, our needs assessment over the past few years [3] revealed that traveling in unfamiliar environments can be challenging and often daunting for people who are blind or visually impaired (B/VI) due to limited tools and information. We envision smart cities of the future that are truly accessible to everyone, including people with disabilities. These cities will benefit from assistive robots that can enhance the safety, efficiency, and independence of B/VI people as they navigate these future urban environments.

To realize this vision of accessible smart cities, assistive robots must be able to effectively interact with people with disabilities, including B/VI travelers. Our research addresses this challenge by exploring meaningful ways in which B/VI people can interact effectively with robots in different scenarios relevant to urban travel. This includes both physical and dialog-based interaction. In this poster we report our initial findings from observations of B/VI adults interacting with a stationary semi-humanoid robot providing informational assistance.

Because sighted people often make incorrect assumptions about visual impairments, we have been careful to incorporate iterative feedback from B/VI adults and from sighted experts who work with B/VI people in each stage of this research. We began by introducing our robot to these sighted experts. We asked for their opinions on how B/VI people should be introduced to the robot and how they might meaningfully interact with the robot. We also asked for their opinions on what they felt were high-value robot tasks that can provide meaningful assistance to B/VI travelers in the context of urban navigation. Next we introduced the robot to several B/VI adults, and recorded their interactions and observations for contrast and comparison with what the sighted experts predicted. We also asked B/VI adults for their opinions about high-value assistive robot tasks in the context of urban travel, and how they would describe the robot to a visually impaired friend.

Based on the findings of these two studies, we enabled our semi-humanoid robot to provide directions to places of interest within a building, using a combination of audio instructions and hand gestures. The two studies also highlighted the importance of B/VI people's first impressions of a robot during human-robot interaction [4], and led us to survey robotics experts and members of the general public to learn how they might describe our robot to a blind person who asks them for a description of the robot before deciding if and how they should interact with the robot. Based on findings from the two studies and the survey, we crafted three descriptions of the same assistive robot and surveyed a new group of B/VI adults on their opinions about these robot descriptions, and on their opinions about how to design a useful robot description that facilitates effective human-robot interaction.

Our findings show that the three descriptions were not statistically different in participants' scores for how the description impacted their willingness to interact with the robot and the helpfulness of the description, and their ranking of the three descriptions. However, their overall comments on the three descriptions provided useful information about how to craft a useful robot description for B/VI people. In this poster, we discuss our findings, provide recommendations on how to introduce an assistive robot to B/VI people in a way that facilitates effective human-robot interaction, and also describe our approaches to implementing a high-value robot task that assists B/VI travelers in the context of urban navigation.

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