

ON SUFFICIENCY OF VERBAL INSTRUCTIONS FOR INDEPENDENT BLIND SHOPPING

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Abstract

A field study of independent blind shopping in a modern supermarket suggests that verbal instructions may be sufficient for retrieving shelved products.

Introduction

The list of the most functionally challenging environments for individuals with visual impairments is topped by shopping complexes [5]. The Food Marketing Institute [1] reports that a typical modern supermarket stocks an average of 45,000 products and has a median store size of 47,500 square feet. Finding individual products, especially products that are not purchased regularly, can take time, even for sighted shoppers, due to the size of stores and the number of available products.

Many people with visual impairments do not shop independently and instead receive assistance from a friend, a relative, an agency volunteer, or a store employee [3]. To enable independent shopping, we have developed ShopTalk (Figure 1), a prototype of a system designed to assist visually impaired shoppers with finding shelved products in grocery stores. ShopTalk does not require any additional hardware or sensors to be installed in the store. Instead, it takes advantage of research evidence suggesting that people with visual impairments share route descriptions and guide each other over cell

phones [2].

ShopTalk assumes that visually impaired people who are independent navigators have the skills needed to understand and follow verbal directions describing routes through large areas of a store – store entrance to aisle, aisle to aisle, and aisle to cashier lane. In these areas, that we call the locomotor space, ShopTalk issues verbal route directions based on a topological map of the store. Since there are no additional sensors installed in the store, ShopTalk does not know where the shopper is actually located and instead assumes the shopper is capable of following the directions and correcting navigational errors independently. In short, the verbal directions guide the shopper to the general area of the target product.

Many grocery stores use inventory systems which place barcodes on the front edge of shelves directly below products. ShopTalk uses these shelf barcodes to create a barcode connectivity matrix (BCM). Whenever the user scans a shelf barcode, the shopper's location in the store immediately becomes known to the system from the scanned barcode. ShopTalk can then instruct the user how to find the location of the target product. If the shopper is in the right aisle and the right side of the aisle, instructions can, for example, be “move two shelves up and scan ten barcodes to the left.” If the shopper is on the wrong side of the right aisle or in a wrong aisle, instructions are issued to guide the shopper to the right location.

Experiment

We conducted a study involving 10 participants with visual impairments from the Logan, UT area over multiple weeks. The locations of shelf barcodes were recorded for three aisles (9, 10, and 11) in Lee's MarketPlace, a local supermarket, resulting in 4,297 items being scanned to build the BCM. One product was randomly chosen from each aisle for a total of three products.

The experiment was performed during the grocery store's normal business hours, starting at 9:00 PM and ending between 10:30 PM and 11:30 PM, depending on a participant's performance. After a one hour training session, each participant was led to the store entrance and was given a shopping basket to carry. The participant was then asked to perform five runs of the experiment's shopping route. The 384 feet route began at the entrance of the store, went to each of the three products, and ended at an entrance to a cashier lane. Participants were not informed beforehand for which products they were going to shop.

The experiment was designed to test five hypotheses. Hypothesis 1 (H1) is that using only verbal route directions, a person with a visual impairment can successfully navigate the locomotor space in a grocery store. Hypotheses 2 (H2) is that verbal instructions based on barcode scans and the BCM are sufficient to guide shoppers with visual impairments to target products. Hypotheses 3, 4, and 5 state that as participants repeatedly perform a shopping task, (H3) the total distance they travel approaches the distance traveled by a blind shopper being guided by a sighted person, (H4) the total time taken to find products approaches the time needed by a blind shopper being guided by a sighted person, and (H5) the number of barcode scans needed to find a target product decreases.

Results

The overall success rate of product retrieval was 100%. All ten participants were able to find all three products in every run. This includes the three participants who had complete vision loss. Verbal route instructions and barcode scans appeared to be sufficient for navigating the store and retrieving target products in grocery aisles. Thus, the null hypotheses associated with research hypotheses H1 and H2 were rejected for our sample, and experimental evidence indicates that both H1 and H2 hold.

To test hypotheses H3 and H4, a sighted guide led a visually impaired shopper to the same products in the same order, as was done during the experiment. During this baseline run, the shopper's guide dog followed the sighted guide. The baseline run was performed once, took 133 seconds to complete, and had a distance of 384 feet. Both the average total distance and the average run time needed to complete a run (see Figure 2) fell over repeated runs and were found to be significant providing sufficient evidence in our data to reject the null hypothesis associated with H3 and H4. The average number of products scanned per run also fell over repeated runs with the decrease found to be significant, allowing the null hypothesis associated with H5 to be rejected. A complete data analysis is in [4].

Summary

ShopTalk provides two major contributions. First, it shows that visually impaired individuals who are independent navigators do not necessarily need a special sensor to navigate a new route in an unknown structured environment. Provided they are given adequate verbal instructions description for the route they need to follow, they can use their everyday navigation skills to successfully navigate routes. Second, a device such as ShopTalk can assist shoppers with visual impairments and allow them to independently shop in a modern grocery store for shelved products.

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Figures



Figure 1. A view of ShopTalk's hardware.

Image description: A user is shown wearing ShopTalk. He is holding a barcode scanner and carrying a shopping basket. He is wearing a backpack. A computer is attached to the backpack's back, and a numeric keypad is attached to the backpack's shoulder strap.

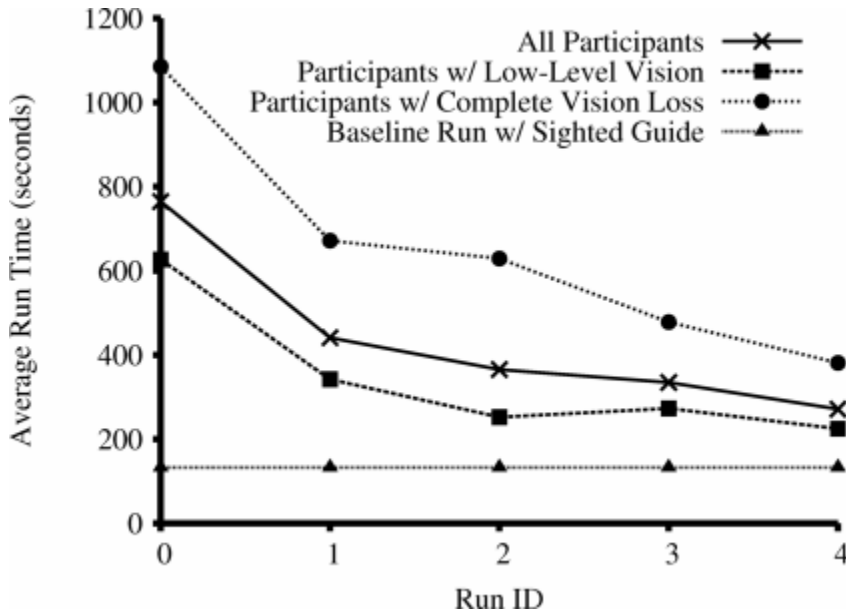


Figure 2. A graph displaying the average time needed to complete each run. Similar patterns were seen for the average total distance and average number of products scanned.

Image description: The graph shows a downward trend, with the initial run having a 765 second average for all participants and the final run having a 272 second average. As a group, low vision participants performed slightly faster than the group as a whole, and participants with complete vision loss performed slightly slower. All groups trend towards the baseline line time of 133 seconds.