Robot-assisted product recognition for blind and visually impaired people

Graduate

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Initial Situation: Around 377,000 visually impaired people currently live in Switzerland, of which 50,000 are completely blind. In total, this corresponds to over 4% of the Swiss population. Impacting various aspects of their lives, this demographic faces daily challenges due to their visual impairment, which also includes essential tasks such as grocery shopping. When attempting to navigate and find products in a supermarket, they encounter significant barriers. The inconsistency in product placement coupled with complex and frequently changing store layouts creates major challenges in locating specific items. Moreover, inaccessible product information, often displayed in small fonts or inadequate formats, restricts their access to crucial details such as ingredients or prices. The declining availability of store staff further exacerbates these barriers, limiting their access to assistance in locating products. As a consequence, their independence and autonomy while shopping is significantly reduced.

Objective: The aim of this thesis is to develop shopping assistance for product recognition for blind and visually impaired people. This is intended to give those affected new perspectives for more autonomy and flexibility when shopping for groceries.
The focus of this work is on object detection, user interface, and marketing aspects. At the end, an initial proof of concept should be developed. The system is intended to facilitate the selection of products without requiring assistance from another person. First, a needs assessment should be carried out in the context of surveys. In order to enable barrier-free shopping, a system should be developed that can both recognize the products in a supermarket and the user's hand to guide them to the desired product. Thereby the challenges for those affected when shopping should be reduced. Finally, the capabilities should be demonstrated and evaluated by means of a user test.

Result: The system empowers blind and visually impaired people to independently carry out a shopping process. Positioned in front of the correct shelf, users can utilize the system's hand navigation to place their desired products into the shopping cart. For this purpose, the user first communicates their shopping list to the system through a headset, specifying both the quantity and the product names. Subsequently, the scene is captured. Utilizing a ZED 2i camera, the system retrieves the current image to scan for the desired products by employing bounding boxes. This procedure relies on custom product recognition developed with a pre-trained model. Following this, the system tracks the user's hand and recognized product. The hand is guided acoustically towards the identified product, continuously assessing the distance between the product and the hand. Once the hand reaches the desired product, the user receives a notification.
During a user test, the system's functionality was validated, confirming that the proof of concept developed in this thesis verifies the feasibility of implementing this shopping cart in reality.
The development of this project is a significant step towards improving the accessibility and independence for people with visual impairments in shopping environments.

Challenges for visually impaired People while Shopping
Own presentment

Proof of Concept
Own presentment

Product and Hand Detection
Own presentment

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Subject Area
Mechatronics and Automation

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