VisionAid

Degree programme: BSc in Electrical Engineering and Information Technology | Specialisation: Embedded Systems
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VisionAid addresses the question of how to enable visually impaired individuals to overcome immobility and navigate the environment safely and independently. It exploits the combined RGB and Point Cloud data streams from a depth camera to accomplish environment awareness and navigation assistance in the form of ground detection and obstacle avoidance.

Motivation

Vision impairment is known to contribute to social isolation, difficulty performing daily tasks and higher risk of accidents. In fact, to ensure safe and independent mobility, visually impaired individuals are usually dependent on help from others, planned experience and assistive solutions to navigate unfamiliar indoor and outdoor environments.
The VisionAid research project was initiated by the Institute for Optimisation and Data Analysis (IODA) at Bern University of Applied Sciences (BFH). Throughout all its stages of development, VisionAid aims towards a viable and financially accessible solution. The Bachelor Thesis of Simeon Bots and Bruno Stucki introduced a mobile prototype capable of object detection, distance estimation and vibrotactile feedback. In the allocated time for their thesis, they pursued a set of general functionality requirements associated with machine vision paving a way for further research and development.

Objectives

This Bachelor Thesis aims to boost the development of a vision aid system through pursuing machine vision solutions for environment awareness, obstacle avoidance and walkable space navigation. The solution explores the use of Text to Speech (TTS) for acoustic feedback and provides a navigation scheme for building navigation instructions. A survey of hardware requirements and hardware-software compatibility issues was performed to ensure successful design and development of any future prototype.

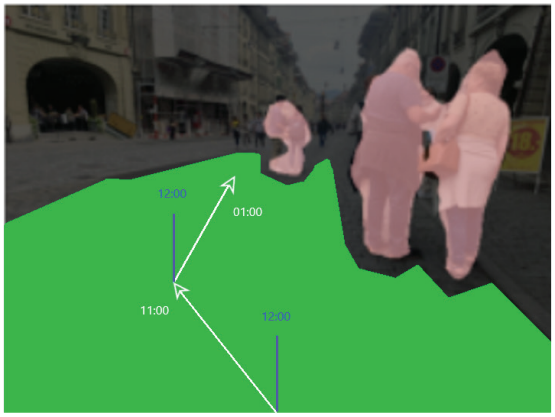
Approach

The chosen approach was to analyse the Point Cloud data and extract information relevant to navigation, such as ground and obstacle detection, while using semantic segmentation on the RGB data for scene description.
In order to achieve the objectives of VisionAid, investigations of existing image segmentation solutions and pre-trained deep learning models were made using Google Colab prior to implementation on hardware. The navigation algorithms were tested using a simulation and a partial implementation of the solution was tested on Bots and Stucki prototype.

Results and Conclusion

The proposed solution consists of three different software modules:
- The semantic segmentation module performs image segmentation on the RGB data stream and utilizes a Tensor Processing Unit (TPU) to address environment awareness.
- The ground detection module runs in a Linux virtual machine mimicking an embedded hardware and it performs obstacle and ground detection.
- The navigation module processes the output of ground detection algorithm and determines how to navigate the available space by performing obstacle avoidance and basic path planning.

This Bachelor Thesis provides proof of concept and proposes a strategy for 2D and 3D data fusion and processing.



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