Active Vision with Human-in-the-Loop for the Visually Impaired

Jacobus C. Lock, G. Cielniak, N. Bellotto

Lincoln Centre for Autonomous Systems (L-CAS)
School of Computer Science, University of Lincoln, UK

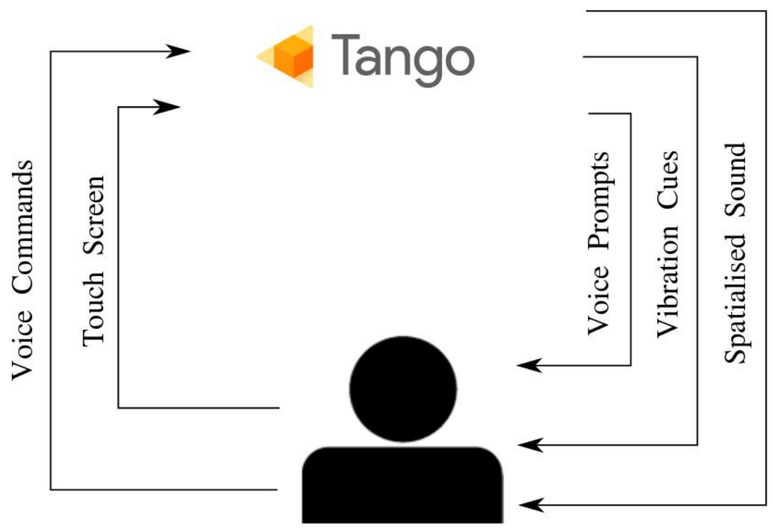
staff.lincoln.ac.uk/jlock | lcas.lincoln.ac.uk

Introduction

- Approx. 30 million visually impaired (VI) people live in the EU and UK, costing close to £30 billion per annum. This number is rising with an ageing population.
- VI people struggle to independently navigate in unfamiliar environments.
- Currently there is no widely-used navigation substitute for the traditional white cane and guide dog which have many limitations (e.g. perception capabilities and training costs).
- In this project we endeavour to create a personalised navigation system for the VI to tackle **"the last 10 yards problem"** in any unfamiliar indoor environment.
- Recent mobile technologies, such as Google Project Tango, give access to powerful localisation features and interface modalities, facilitating **user acceptability and usability**.

Project Progress

- The system includes an interface for a VI user with **multi-modal feedback** [1]. These modes include vibration, spatial audio and voice cues.



- A virtual cane detects obstacles at close range using depth information from the Tango's RGB-D camera and makes the device vibrate.
- Spatialised audio and voice cues guide the user towards their destinations using bone conducting headphones.

Project Objectives

1. Build a **multimodal human-machine interface** providing feedback from a basic navigation system to a VI user.
2. Create an efficient **adaptive control system with human-in-the-loop** to guide a VI user, taking into account his/her skill and actual performance.
3. Evaluate the proposed system with **real VI people** in an unfamiliar indoor environment.

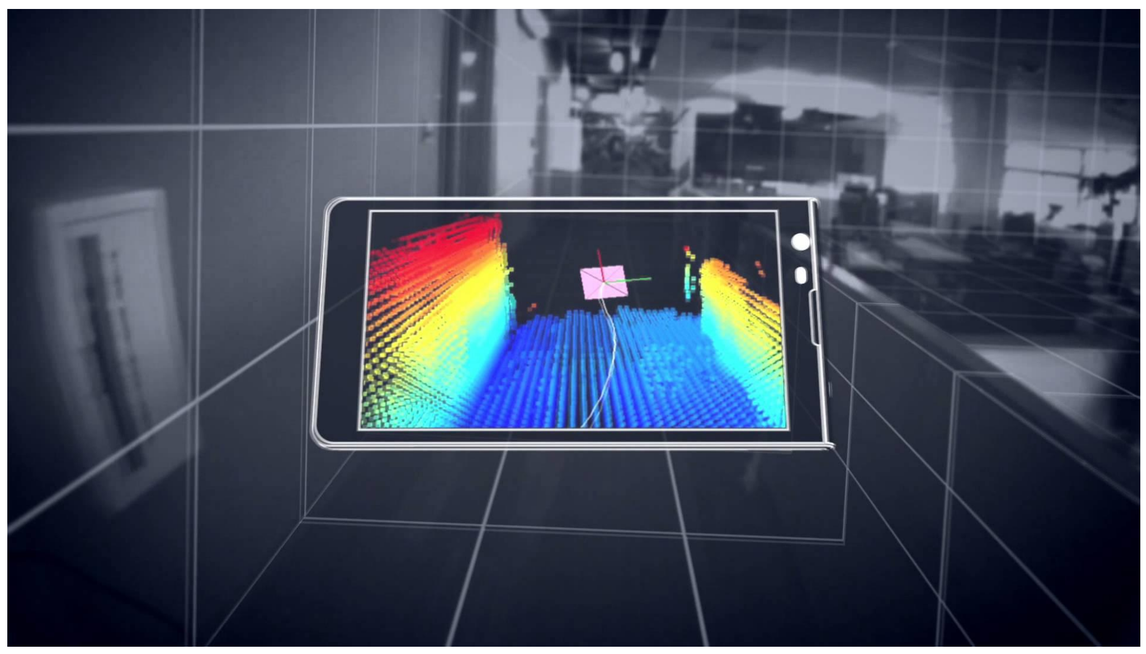
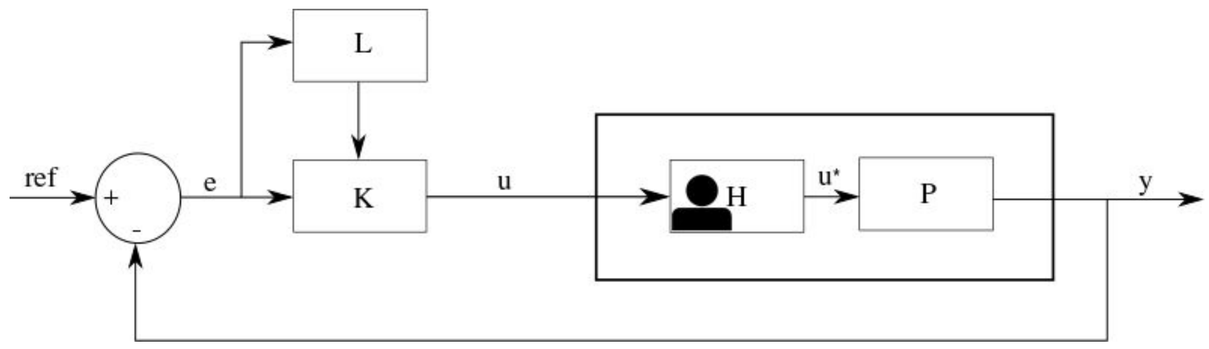


Image courtesy of Google

Current and Future Work

- User tests are currently being prepared with different experimental setups and configurations to see how different interface parameters affect navigation performance.
- An adaptive module (L) is being developed which will adjust the interface parameters (u) according to the user's navigation skills and performance using a novel approach for **progressive co-adaptation** [2].



References

1. *N. Bellotto*. A Multimodal Smartphone Interface for Active Perception by Visually Impaired. In IEEE SMC International Workshop on Human Machine Systems, Cyborgs and Enhancing Devices (HUMASCEND), *2013*.
2. *P. Gallina, N. Bellotto, and M. Di Luca*. Progressive Co-Adaptation in Human-Machine Interaction. 12th International Conference on Informatics in Control Proceedings (ICINCO), *2015*.

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