Artificial Vision for Blind People

Project proposal

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1 Goals

Currently there are many advances in Computer Vision that can do things that were considered impossible for a machine, some years ago.

These advances are used mainly for robotic applications.

With this project we want to integrate many Computer Vision algorithms, such as, the recognition of places or locations, people and objects [1, 3, 5, 6], into a portable system that can be used by a blind person or a person with serious vision difficulties, and help them navigate the real world and make life easier for them as a whole. The goal is to take advantage of 3D cameras [2, 4].

The code will be done using PyTorch on Linux. The goal is to have the code running on an embedded system, which might require modifications to several algorithms to allow them to run with limited resources. We will also evaluate the use of cloud computing for supporting the most demanding algorithms.

2 Work plan

The project has the following tasks:

T1 Introduction to computer vision algorithms (3 weeks).

T2 Study the requirements for the application and integrate already existing code (4 weeks).

T3 Implement new code to solve some of the remaining necessary requirements and integrate everything in the prototype (6 weeks).

T4 Write the project's report (2 weeks).

3 Technical and Academic Requirements

Be able to program using Python on Linux, use a source code repository and produce documentation (using doxygen, sphinx or other similar tool).

It is desirable that the student has grades above 13 on the following courses: Estruturas de Dados, Probabilidades e Estatística, Inteligência Artificial.

4 Expected Results

- prototype that solves the basic vision tasks with audio interface for blind people
- source code and documentation of all code developed
- project report

5 References

[1] Luís A. Alexandre. 3D descriptors for object and category recognition: a comparative evaluation. In *Workshop on Color-Depth Camera Fusion in Robotics at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Vilamoura, Portugal, October 2012.

[2] Luís A. Alexandre. Set distance functions for 3D object recognition. In *18th Iberoamerican Congress on Pattern Recognition*, Lecture Notes in Computer Science, Havana, Cuba, November 2013. Springer.

[3] Luís A. Alexandre. 3D object recognition using convolutional neural networks with transfer learning between input channels. In *13th International Conference on Intelligent Autonomous Systems*, volume 301 of *Advances in Intelligent Systems and Computing Series*, Padova, Italy, July 2014. Springer.

[4] Luís A. Alexandre. 3D computer vision: From points to concepts. In Ana Fred, Maria De Marsico, and Mário Figueiredo, editors, *Pattern Recognition: Applications and Methods: 4th International Conference, ICPRAM 2015, Lisbon, Portugal, January 10-12, 2015, Revised Selected Papers*, pages 3–14. Springer International Publishing, 2015.

[5] Joao Maria, Joao Amaro, Gabriel Falcao, and Luís A. Alexandre. Stacked autoencoders using low-power accelerated architectures for object recognition in autonomous systems. *Neural Processing Letters*, 43(2):445–458, 2016.

[6] Abel Zacarias and L.A. Alexandre. Application of lifelong learning with CNNs to visual robotic classification tasks. In *24th Portuguese Conference on Pattern Recognition, RECPAD 2018*, Coimbra, Portugal, October 2018.