

Università degli studi di Brescia

Corso di Laurea Magistrale in Ingegneria Informatica

Corso di Digital Image Processing



ANDROID SINGLE LENS DEPTH SCANNER

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Overview



- Automatic recognition of pedestrian crossing
- Estimation of target distance from the camera lens

Main idea

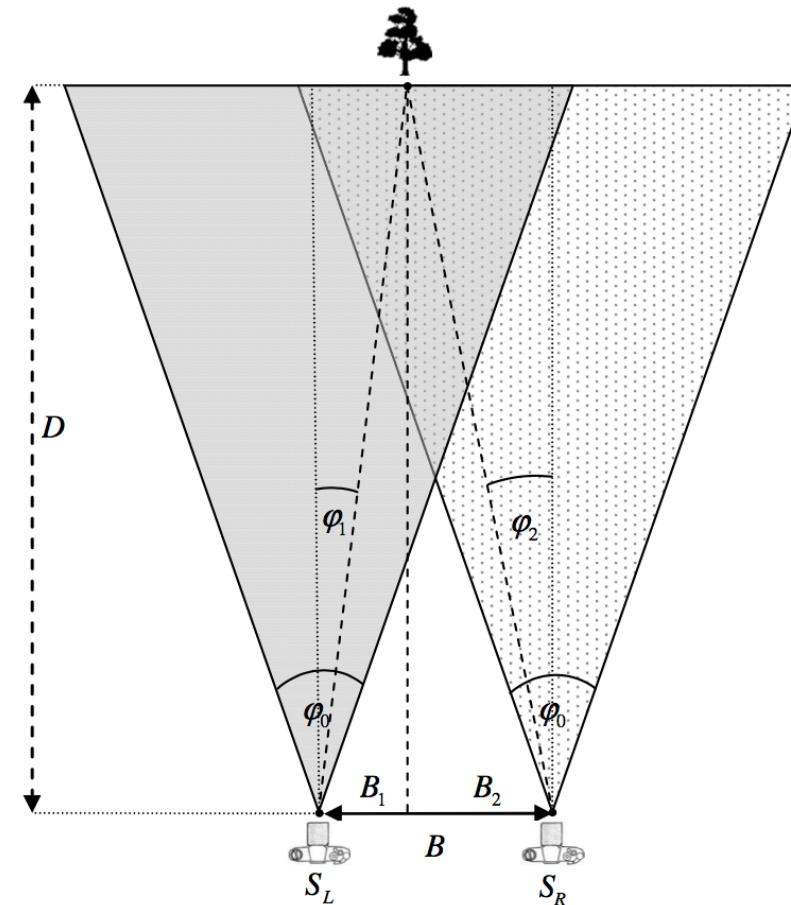


1. Taking two pictures of the same scene from two different point of view
2. Search the first picture for the road sign
3. Search the second picture for the same road sign at the **same height**
4. Compute the disparity
5. Estimate the depth of the target



1. Taking the pictures

The second picture has to be taken after moving the camera horizontally being cautious not to move the camera vertically and not to rotate it along any axis.



2. First search

Two steps:

1. Haar Cascade Classification

Object Detection using Haar feature-based cascade classifiers is an effective object detection method¹.

It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.

2. ORB Features Extraction and Matching

Fast features extractor used for matching candidates subsamples of the original image (obtained at step one) against a provided model in order to improve the detection of the Haar Cascade.

¹ Paul Viola and Michael Jones - "Rapid Object Detection using a Boosted Cascade of Simple Features" 2001

After Haar Cascade

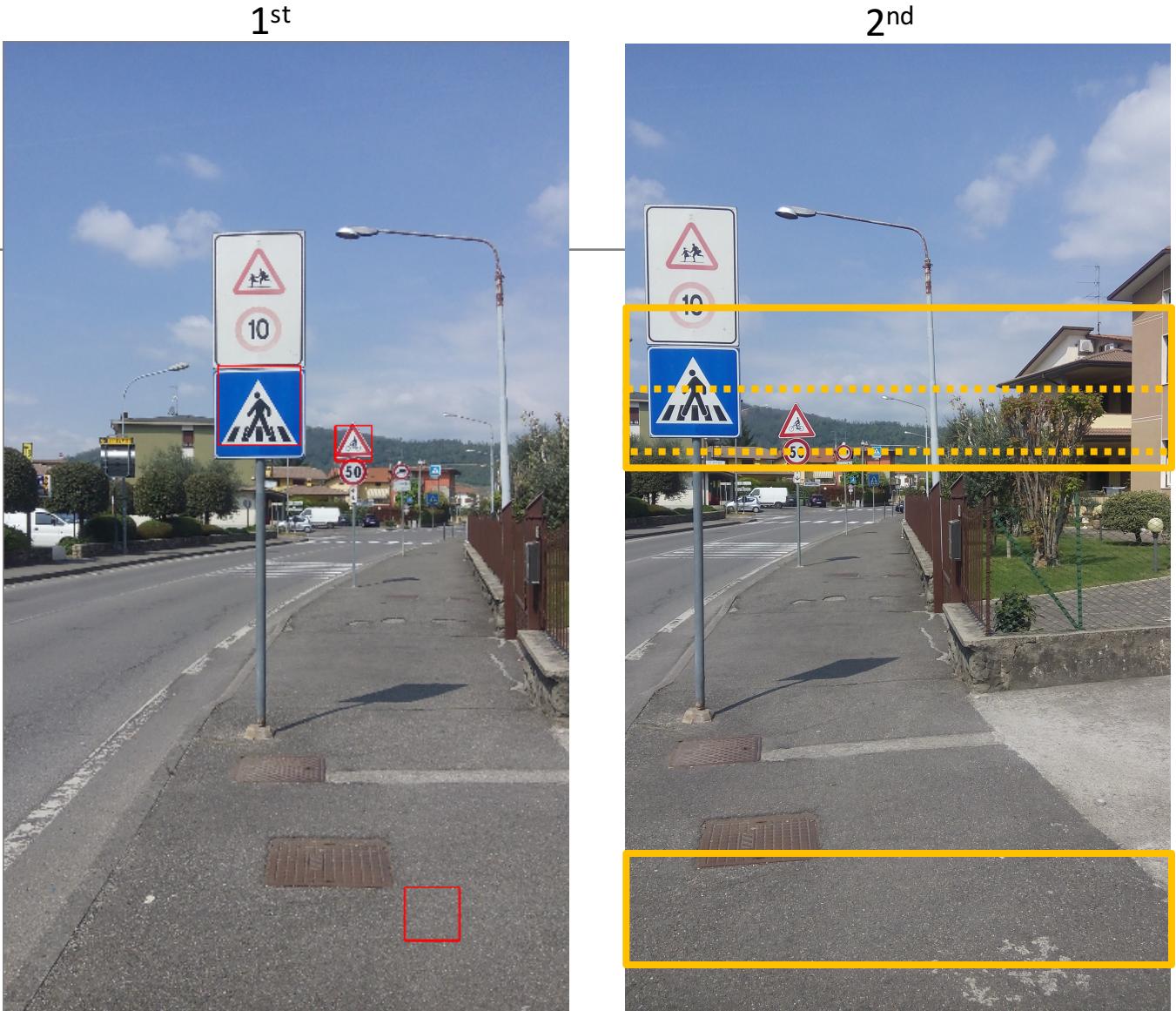


After ORB



3. Second search

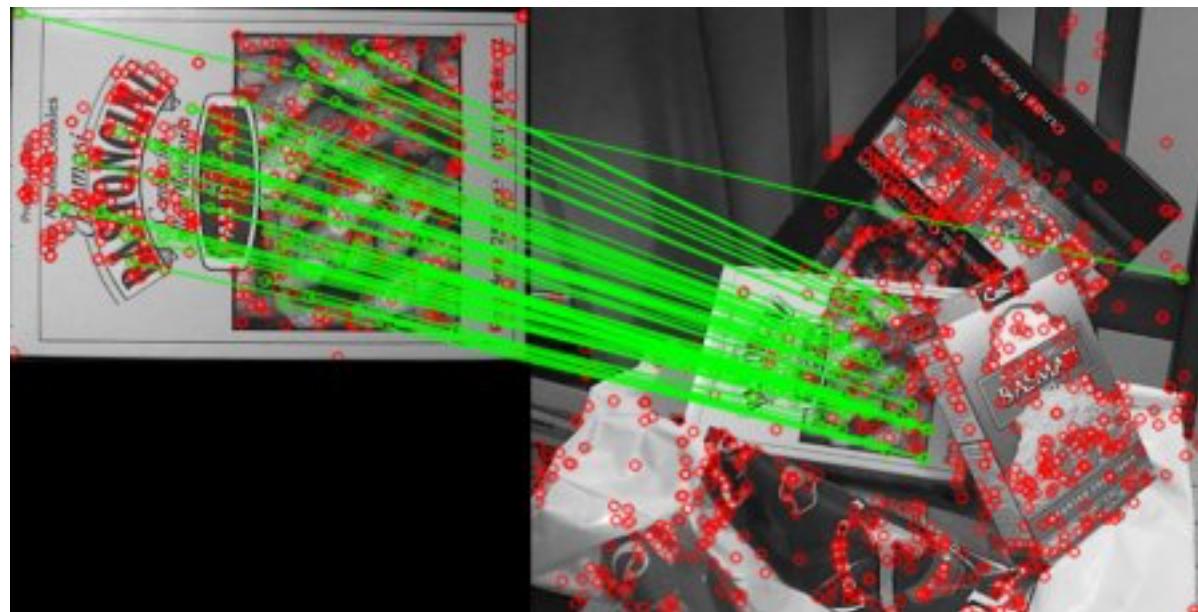
The same technique applied during the first search is replicated on a subset of the second picture, extracted starting from matches obtained from the first search.



4. Disparity (1)

Each road sign in the first picture is paired with the correspondent one in the second picture.

The paring is based on the mean distance between ORB features extracted from the two boxes.



4. Disparity (2)

Once that all boxes are paired the disparity is computed adding the “self” disparity of every member of the pair.

As “self” disparity is intended the pixel distance of the center of the box from the focal axis of the image.

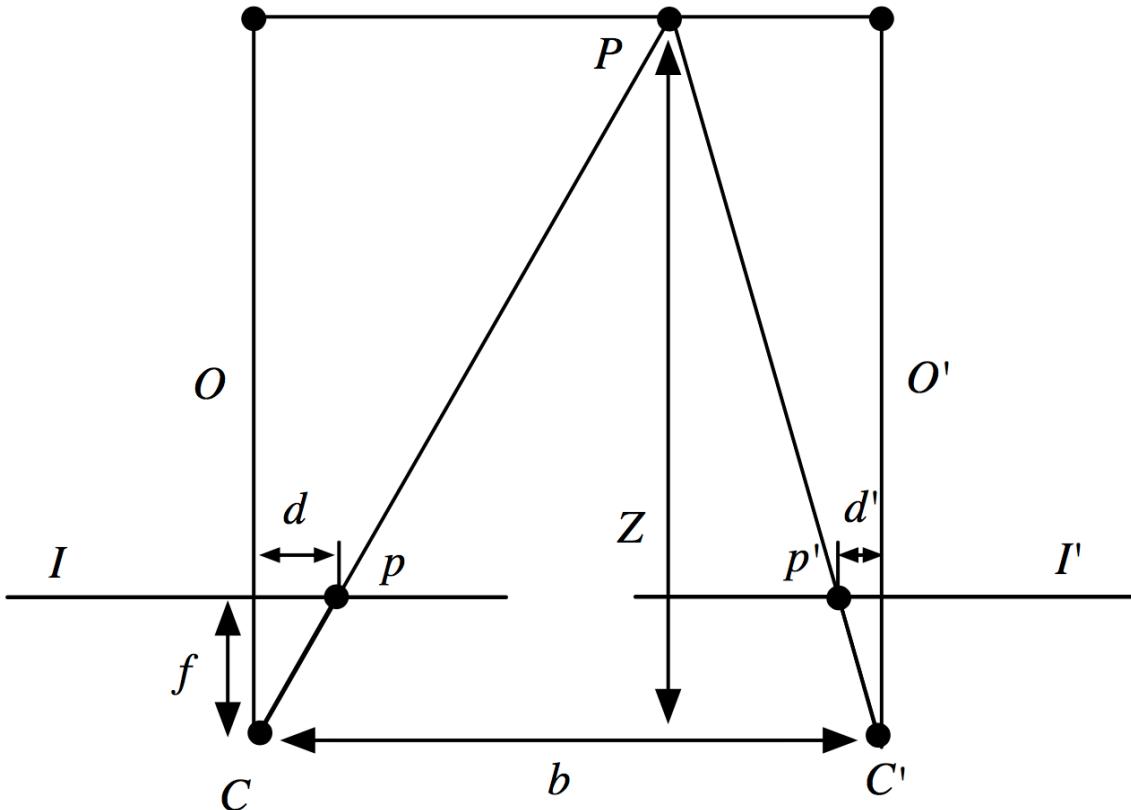


5. Estimate depth

The depth of the target is computed following the formula below

$$\frac{b}{Z} = \frac{b - (d + d')}{Z - f} = \frac{d + d'}{f}$$

Due to poor performances of mobile accelerometer we were unable to compute "**b**" with sufficient accuracy

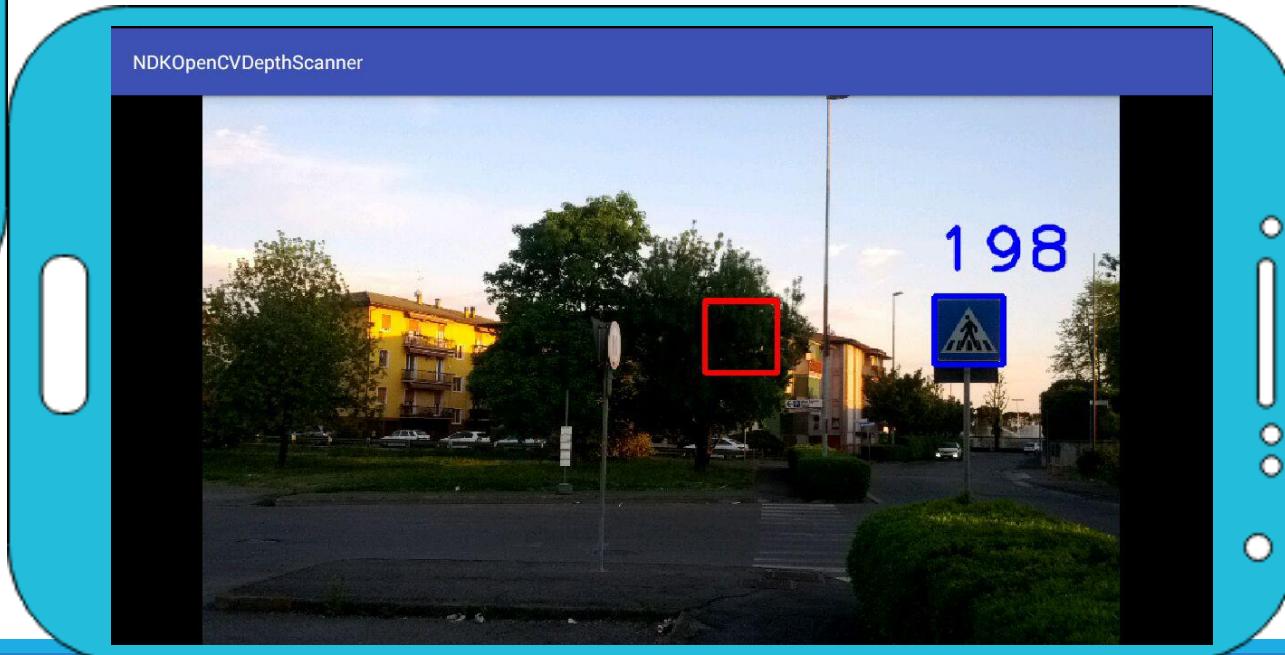
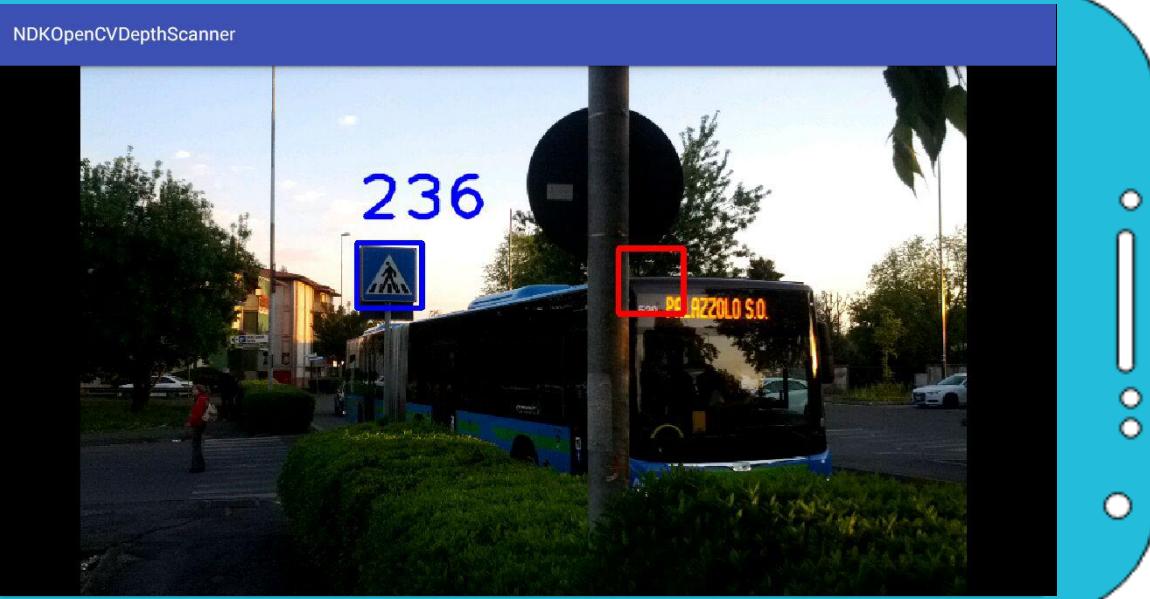


“Measuring Distance with Mobile Phones Using Single-Camera Stereo Vision” - Clemens Holzmann, Matthias Hochgatterer

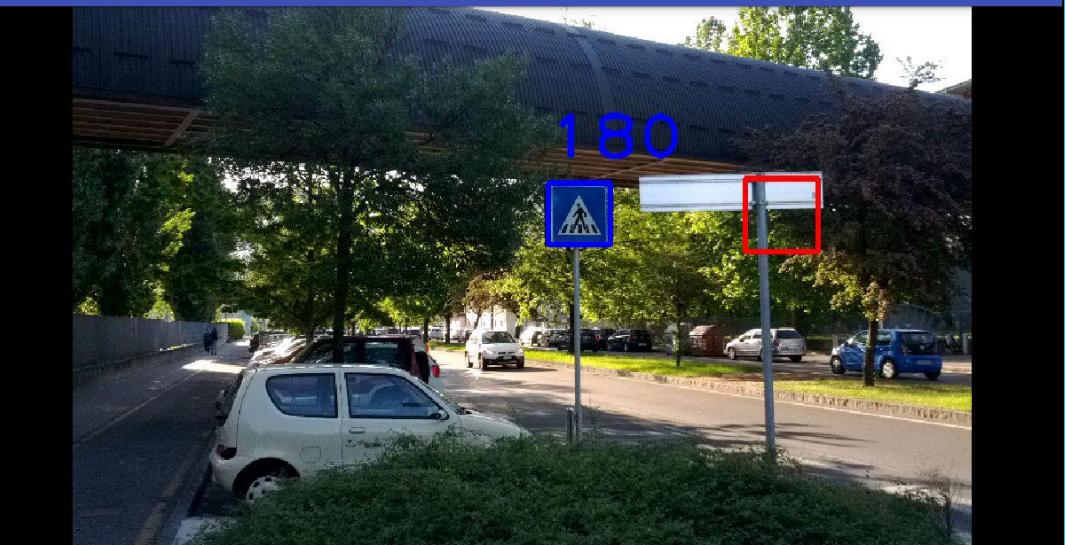
Mobile app

Listener on events

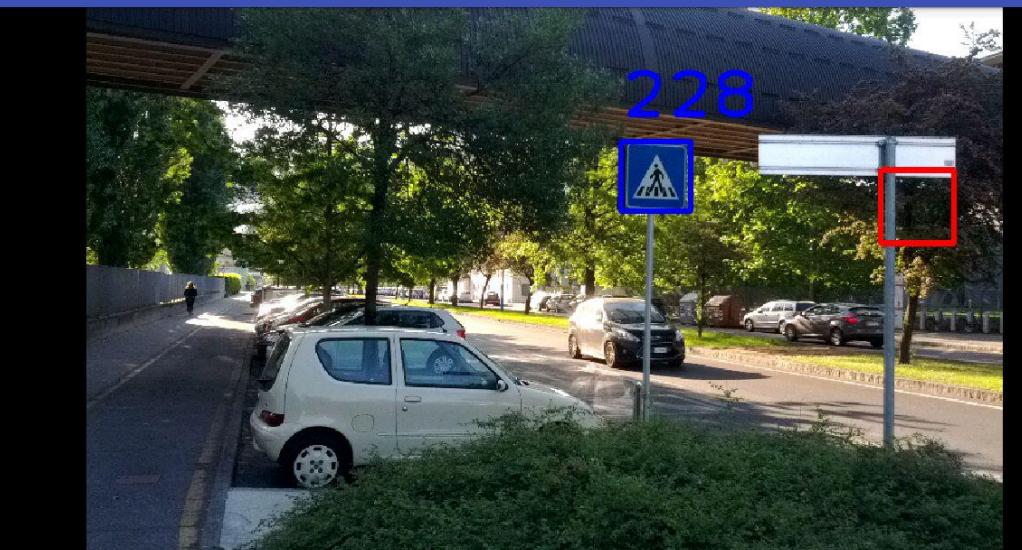
1. OnTouch DOWN pick the first frame
2. Move horizontal direction
3. OnTouch UP pick the second frame
4. Keep the second frame and show the result of computation
5. Repeat



NDKOpenCVDepthScanner



NDKOpenCVDepthScanner



Future development

- Training more than one classifier in order to detect more road sign
- C++ code optimization
- Development of fast and stable code for derive displacement given noisy accelerometer data

