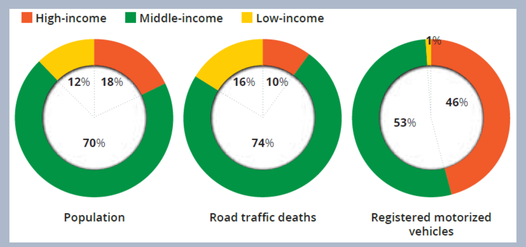
DRIVING BEHAVIOUR SUPERVISION SYSTEM BASED ON COMPUTER VISION

GEORGE PARASKEVOPOULOS
UNIVERSITY OF PATRAS
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
Contact: gparaskevo@upnet.gr, rgparask@gmail.com

Introduction

Modern cars are getting smarter using accident prevention systems which have led to a decrease in road accidents in a global scale. Despite that, there still is lack of an affordable safety solution for people with lower income.

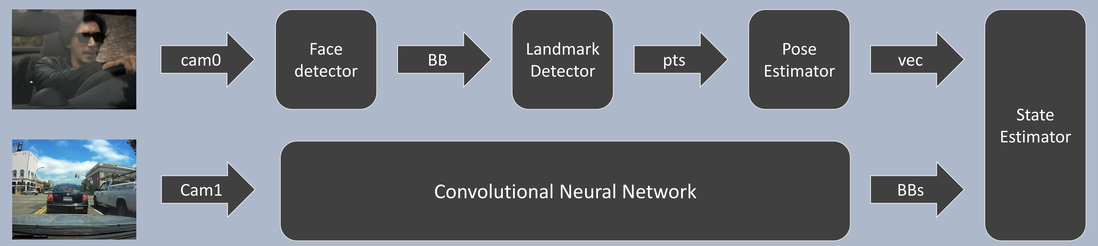


Objective

Goal of this diploma thesis is the development of a complete accident prevention system based on computer vision technics, while using cheap low-power hardware. This system should be able to:

- Monitor the driver to ensure alertness
- Monitor the road to detect obstacles
- Alert the driver of a dangerous situation without being annoying and intrusive
- Run efficiently on low-power hardware (e.g. smartphones)

Proposed system



Face analysis

The analysis of the drivers face is separated into three steps:

1. Face detection
2. Landmark detection
3. Pose estimation

Methods used

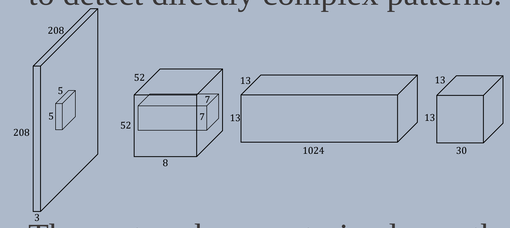
Face detection: OpenCV implementation of Viola Jones [1] algorithm

Landmark detection: Dlib-OpenCV implementation of Kazemi-Sullivan [2] method

Pose estimation: Perspective-n-Point problem solution using OpenCV implementation of the Levemberg-Marquardt algorithm

Road analysis

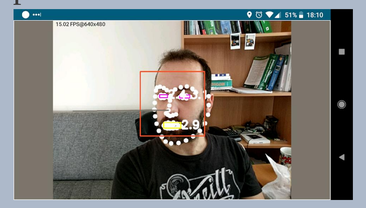
The road analysis is done using a convolutional neural network based on **YOLOv2**. [3] The designed network consists of only three wide convolutional layers, in the sense that the filters used have larger size to detect directly complex patterns.



The network was trained on the PASCAL VOC [4] dataset using Darknet [5]. Darkflow [6] was used to generate a Tensorflow protobuf file to implement on an Android device

Results

Real-time head pose estimation detecting distracted driving, running on a smartphone.



The pose estimation works robustly on a variety of environments, unless scene is too dark and is mostly limited by the face detector.

Real-time vehicle and pedestrian detection, running on a smartphone

The neural network's performance is not great, but it is not as critical as in vehicle control applications

Future work

- Redesign of the neural network
- Dataset manipulation to train a better network
- Development of a State Estimator that combines information about the driver and the road.

References

[1] Paul Viola and Michael Jones. Rapid object detection using a boosted cascade of simple features. 2001.
[2] Vahid Kazemi and Josephine Sullivan. «One Millisecond Face Alignment with an Ensemble of Regression Trees». In: The IEEE Conference on Computer Vision and Pattern Recognition (CVPR). June 2014.
[3] Joseph Redmon and Ali Farhadi. «YOLO9000: Better, Faster, Stronger». In: arXiv preprint arXiv:1612.08242 (2016).
[4] Mark Everingham et. al. «The Pascal Visual Object Classes (VOC) Challenge». In: International Journal of Computer Vision 88.2 (June 2010)
[5] Joseph Redmon. Darknet: Open Source Neural Networks in C. http://pjreddie.com/darknet/. 2013–2016.
[6] Trieu H. Trinh. Darkflow: a Tensorflow implementation of Darknet. url: https://github.com/thtrieu/darkflow.