AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer and Systems Engineering

Real Time Detection of Distracted Driver Technique

A Thesis submitted in partial fulfillment of the requirements of
Master of Science in Electrical Engineering
(Computer and Systems Engineering)

by

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Bachelor of Science in Electrical Engineering
(Computer and Systems Engineering)
Faculty of Engineering, Ain Shams University, 2011

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Cairo, 2020

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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University. The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

Faculty of Engineering – Ain Shams University
Computer and Systems Engineering Department

Thesis title: **"Real Time Detection of Distracted Driver Technique"**
Submitted by: **Youssra Hossam Eldeen Abdelsameai Elqattan**
Degree: **Master of Science degree in Electrical Engineering**

Abstract

It has been noticed over the past few years that driver distraction has been responsible for good percentage of road accidents. Moreover, cell phone usage has been reported to be a major cause for driver distraction-based road accidents. These observations led governments to ban cell phone usage among distracted drivers. The new regulations for banning cell phone usage while driving raised the need for automated systems to monitor drivers and report cell phone usage violations. Previous studies in this area show some systems for detecting driver distraction based on computer vision techniques and other systems based on vehicle behavior. Among the computer vision based systems, some are intended for alerting distracted driver and hence are mounted inside the vehicles. While others are roadside setup to report cell phone usage violations. We propose an integrated system to automatically detect, track, and report distracted drivers. Based on real time camera feed, our Convolutional Neural Networks (CNN) detect vehicles drivers and hence classify their attention. An automatic license plate recognition module records distracted drivers' vehicles' plate numbers and report them through a simple web-based server component. To train and test our CNNs, we collected and annotated various video footage of volunteering drivers from a camera mounted on a patrol car as well as a roadside gantry. We collected two

datasets for the roadside and patrol setups. Then, we trained a CNN based classifier to classify drivers' behavior as whether they are driving safely or using their cell phones. Our system achieved 89% driver detections and 95% classification accuracy on a recorded test set. We also report the results of one full day run of the roadside setup which resulted in 100% recall of cell phone usage and 46% precision and discuss these results.

Thesis Summary

Summary

This thesis proposes a system for detecting, tracking and reporting cell phone distracted drivers. The thesis is divided into seven chapters as listed below

Chapter 1

Gives an introduction about the dangers and damages associated with driver distraction and shows the motivation behind developing our driver cell phone distraction detection system. It explains what driver distraction is and what are the causes and types of driver distraction. It also gives an overview of our proposed system for driver cell phone distraction detection.

Chapter 2

Gives an overview of the state of the art in driver distraction detection including on board and roadside systems. It also reviews some of the datasets used in the literature for driver distraction classification and some of the methodologies followed in collecting those datasets.

Chapter 3

Explains the main approaches for image classification which are categorized into traditional and deep learning approaches. It demonstrates an example of traditional approaches in the form of feature extraction using Histogram of Oriented Gradients followed by classification using Support Vector Machines. It also explains Artificial Neural Networks (ANNs) and Convolutional Neural Networks (CNNs) used in deep learning approaches. It briefly explains transfer learning as a way to train CNNs. It then shows what overfitting and generalization are, and lists some common practices used to combat overfitting. It also gives a brief overview of data augmentation and discusses the problem of data class imbalance and the different ways to solve it. It shows some of the classification models' evaluation metrics. The chapter also reviews some of the state of the art object detection algorithms as object detection forms an essential part of our driver cell phone usage detection solution.

Chapter 4

Shows the overall design of the system and explains the different parts comprising it from image acquisition, to driver detection and driver cell phone usage classification, automatic plate number recognition, driver tracking, GPS used to associate the cell phone usage violation with the location it happened in, and the web dashboard used for registering, viewing, issuing and deleting the recorded violations. Lastly, we briefly review some of the frameworks and tools used in developing the system.

Chapter 5

Describes the dataset used to train the driver cell phone usage classifier, how we collected it, what challenges we faced, and how the dataset was annotated, balanced, augmented, and split into train and test sets. The chapter gives some statistics about the images in each class of the dataset, and finally, shows some samples of the images in the dataset.

Chapter 6

Shows the experiments we performed to choose the object detection algorithm's parameters. The experiments performed to select the Classifier Model are also discussed in this chapter. The chapter also shows the performance gain in the classification when a driver tracker is added to the system. Finally, the results of a full day street test are shown.

Chapter 7

Gives a brief conclusion of our work, and presents some possible future work extending this work.

Key words: CNN, driver distraction detection, computer vision, object detection, image classification, object tracking.

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