شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

HANAA ALY

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جامعة عين شمس

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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

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HANAA ALY

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer Engineering and Systems

Driver Distraction Identification with Deep Learning

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

by

Eng. Mohamed Hussien Saad Hasanain

Bachelor of Science in Electrical Engineering
(Computer Engineering and Systems)
Faculty of Engineering, Ain Shams University, 2013

Supervised By

Prof. Dr. Hazem M. Abbass

Prof. Dr. Mahmoud I. Khalil

Cairo, 2021

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Date: 03 April 2021

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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Thesis Summary

This study discusses the problem of driver distractions and how to mitigate it by detecting driver distractions using deeplearning models. The thesis describes all the steps done starting from collecting the dataset till building, training, and analyzing the models.

The thesis organized as follows:

Chapter 1 starts with talking about road accidents and how driver distractions are a main part of the problem. Then the chapter discusses the shortage of the existing driver distractions datasets and models due to the lack of diversity of lighting conditions. Finally, this chapter presents the contributions of this research to treat this shortage by recording a driver distractions dataset that represents the real driving experience and train seven models using the collected data.

Chapter 2 discusses the theoretical background of this thesis and presents the required important concept for this research understanding. This chapter starts with presenting the concept of NoIR camera. Then the chapter discusses the deeplearning concepts.

Chapter 3 provides a comprehensive study about the existing studies in the literature of driver distraction recognition. Then discusses the contribution and shortage of each study.

Chapter 4 is concerned with the methodology and the steps of the two main parts of this research, dataset collection and models training. In the first part, this chapter introduces the steps of dataset collection and annotation. In the second part, the methodology of building and training the deeplearning models for driving distractions recognition is discussed.

Chapter 5 shows the experimental results of the dataset and the trained models. For the dataset, this chapter presented the dataset analysis and compares this dataset with other datasets. For the trained models, this chapter shows the accuracy of each model and the analysis of these models using different techniques like confusion matrix, t-SNE representation, and saliency map.

Chapter 6 presents the conclusion of the thesis in the first part of it. In the second part, this chapter introduces the suggestions for future extensions related to the enhancement of the dataset, the trained models, and applications.

Keywords: distracted driver, action recognition, computer vision, machine learning, driver distraction, deep learning, distraction mitigation system, NoIR camera, driver distractions dataset

Abstract

Road accidents are the eighth leading cause of death for people of all ages while it is the first cause of death for children and young people. Every 24 seconds there is a person in the world who dies due to a road accident. The risk factor of road accidents increases if the driver is distracted. One way of decreasing road accidents is to detect the different driver distractions and use this detection as an input to a driver distraction mitigation system. Here comes the role of machine learning as one of the most recent approaches in driver distraction detection problem.

The reliability of the machine learning models depending mainly on how much the data represents the real world. Using normal RGB cameras in most of driving distractions datasets makes these datasets away from the real driving experience as RGB cameras cannot capture low lighting samples. The rest of the driver distractions datasets are either recorded in a simulation environment or captured using IR cameras at low lighting conditions which also makes these datasets away from the real driving experience.

In order of that, the first main contribution of the thesis is presenting the largest ten-classes driver distractions dataset to date including temporal information and low lighting support. The dataset was captured using only one sensor, a raspberry pi NoIR (No IR filter) camera. The NoIR technology enables the camera sensor to captures RGB and IR data at the same time combined which enables capturing data at different lighting conditions using IR LEDs. A number of 70 drivers of both genders and five different car models were involved in this dataset.

The second main contribution of the thesis is building seven End-To-End deep learning models, including three sequence models, and training them using the collected dataset. After that, we compared the seven models and analyzed the performance of each model using different techniques like confusion matrix, t-SNE representation, and saliency map. Results have shown that, among the seven models, the model with Convolutional-GRU backbone offered the best test-accuracy (95.48%). While among the non-sequence models, the model with VGG16 backbone offered the best test-accuracy (93.05%).