بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

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

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

MONA MAGHRABY

3D SEMANTIC SEGMENTATION USING CAMERA-LIDAR SENSOR FUSION FOR AUTONOMOUS DRIVING

By

Khalid Mohamed Naguib Elmadawi

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Electronics and Communication Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

3D SEMANTIC SEGMENTATION USING CAMERA-LIDAR SENSOR FUSION FOR AUTONOMOUS DRIVING

By
Khalid Mohamed Naguib Elmadawi

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Electronics and Communication Engineering

Under the Supervision of

Prof. Dr. Hanan Ahmed Kamal

……..

Professor of Control
Electronics and Communication
Engineering
Faculty of Engineering, Cairo University

A.Prof. Dr. Omar Ahmed Nasr

……..

Associate Professor
Electronics and Communication
Engineering
Faculty of Engineering, Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

3D SEMANTIC SEGMENTATION USING CAMERA-LIDAR SENSOR FUSION FOR AUTONOMOUS DRIVING

By
Khalid Mohamed Naguib Elmadawi

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Electronics and Communication Engineering

Approved by the Examining Committee

_____
Prof. Dr. Hanan Ahmed Kamal, Thesis Main Advisor

_____
Associate Prof. Dr. Omar Ahmed Nasr, Advisor

_____
Prof. Dr. Mohsen Abdelrazek Rashwan, Internal Examiner

_____
Prof. Dr. Sherif Mahdi Abdou, External Examiner
Professor in Faculty of Computers and Artificial Intelligence

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2021

Engineer's Name: Khalid Mohamed Naguib Elmadawi
Date of Birth: 09/06/1990
Nationality: Egyptian
E-mail: Khaled.elmadawi@gmail.com
Phone: 01149669927
Address: 15 Tiba Gardens-3B/6October First/Giza

Registration Date: 01/03/2016
Awarding Date: …./…./2021
Degree: Master of Science
Department: Electronics and Communication Engineering

Supervisors:

Prof. Hanan Ahmed Kamal
Associate Prof. Omar Ahmed Nasr

Examiners:

Prof. Hanan Ahmed Kamal (Thesis main advisor)
A.Prof. Omar Ahmed Nasr (Advisor)
Prof. Mohsen Abdelrazek Rashwan (Internal examiner)
Prof. Sherif Mahdi Abdou (External examiner)
Professor in Faculty of Computers and Artificial Intelligence.

Title of Thesis:

3D SEMANTIC SEGMENTATION USING CAMERA-LIDAR SENSOR FUSION FOR AUTONOMOUS DRIVING

Key Words:
Sensor Fusion; Environment Perception; Early Fusion; Middle Fusion; Spherical Grid Map

Summary:

This research improves the environment sensing in control systems through multi-sensor fusion. We are fusing Camera raw image data with LiDAR Point cloud resulting from having a colored point cloud, represented in a spherical grid map representation. We used the fused data in early and mid-level fusion algorithms. We evaluate our algorithms on the KITTI dataset, which provides semantic segmentation for different classes such as Cars, Pedestrians, and cyclists. We evaluated our work on two states of art architectures, namely SqueezeSeg and PointSeg, resulting in improving the mIOU score to 10% in both cases relative to the LiDAR only baseline.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: khalid elmadawi Date: …/…/…..

Signature:

Dedication

I would like to dedicate my thesis to family who supported me, and to my professors and colleagues that tough me and offered me a lot to achieve my master degree.

Acknowledgments

First, I would like to thank God for helping me and giving me the strength to overcome all the obstacles out of my hand. Then Great thanks to my colleagues in Valeo who shared my effort in my research and supporting me till we have achieved successful results. Thanks, and gratitude to Dr. Hanan Kamel and Dr. Omar Nasr for their guidance and contribution in our work through my whole research period. This work would not be carried out without the support coming from the electronics and communications department members in the Faculty of Engineering of Cairo University.

Table of Contents

List of Tables

List of Figures