Proposal for Master Thesis:
One Two
Masters Thesis in Mechatronics
Kristian Gonzalez, September 2019

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science (M.Sc.).

Supervisor:	Prof. Dr. Wolfgang Ertel
	Ravensburg-Weingarten University of Applied Sciences
Co-supervisor:	Prof. Dr. Stefan Elser
	Ravensburg-Weingarten University of Applied Sciences

1 Introduction

Computer vision is a field that has grown explosively in the last few years, very much in thanks to the utilization of Convolutional Neural Networks, or CNN's, to accurately identify different kinds of information from raw image data. This capability has led to many different subfields of research, including 3D localization of objects using a variety of sensor setups. To that end, a few questions naturally arise: how many sensors are needed to accurately locate objects, and what tradeoffs exist for using more or less sensors? To that end, a paper is proposed to seek out a comparison between two specific sensor setups. The first sensor setup would use only camera data, and a derived stereo disparity image, to detect and localize the desired object of interest, specifically cars. The second sensor setup would use a single camera and a single lidar to perform the same task. The nature of the detection required would be a 3D bounding box, expressed as a box with real-world distances to describe an object's relative x, y, and z coordinates as well as its height, width, and length. The dataset that would be used for this task is not yet confirmed, but is currently one out of several possibilities:

- The KITTI dataset (3D detection task)
- Oxford RobotCar dataset (3D detection task)
- ???
- ???-2

Each of these possible datasets will be expanded upon below, describing their merits and drawbacks.

2 Literature Search Questions

There are multiple questions to answer regarding what is possible in this project. To that end, a literature search is underway to answer:

- What is the state of the art in current stereo vision-based object detection?
- What is the state of the art in current camera/lidar-based object detection?

- What dataset meets the required criteria for usage in this project? A dataset must have rgb data, stereo data or the ability to generate it, lidar data, and 3D bounding boxes.
- How are 3D bounding boxes evaluated, and what standard is used to obtain a score, such as precision, recall, and average precision?

2.1 State of the Art: Stereo-Based Object Detection

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2.2 State of the Art: Camera/Lidar-Based Object Detection

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2.3 Valid Datasets, and the Most Qualified to be Used

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2.4 3D Bounding Box Evaluation

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3 Project Schedule / Timeline

In order to meet all requirements while also satisfying educational program requirements, a proposed timeline is provided below. Notable dates here include the official start of the thesis, the final date of the thesis, including presentation and document turn-in.

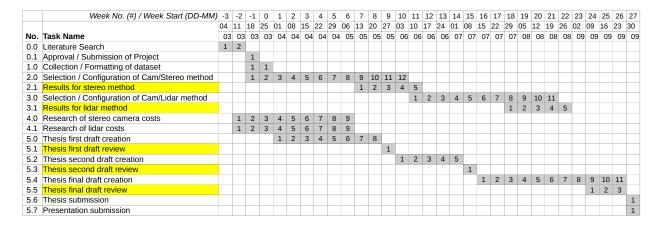| No.	Week No. (#) / Week Start (DD-MM)	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
		04	11	18	25	01	08	15	22	29	06	13	20	27	03	10	17	24	01	08	15	22	29	05	12	19	26	02	09	16	23	30
	Task Name	03	03	03	03	04	04	04	04	04	05	05	05	05	06	06	06	06	07	07	07	07	07	08	08	08	08	09	09	09	09	09
0.0	Literature Search	1	2																													
0.1	Approval / Submission of Project			1																												
1.0	Collection / Formatting of dataset			1	1																											
2.0	Selection / Configuration of Cam/Stereo method			1	2	3	4	5	6	7	8	9	10	11	12																	
2.1	Results for stereo method											1	2	3	4	5																
3.0	Selection / Configuration of Cam/Lidar method														1	2	3	4	5	6	7	8	9	10	11							
3.1	Results for lidar method																					1	2	3	4	5						
4.0	Research of stereo camera costs		1	2	3	4	5	6	7	8	9																					
4.1	Research of lidar costs		1	2	3	4	5	6	7	8	9																					
5.0	Thesis first draft creation				1	2	3	4	5	6	7	8																				
5.1	Thesis first draft review												1																			
5.2	Thesis second draft creation														1	2	3	4	5													
5.3	Thesis second draft review																			1												
5.4	Thesis final draft creation																			1	2	3	4	5	6	7	8	9	10	11		
5.5	Thesis final draft review																												1	2	3	
5.6	Thesis submission																															1
5.7	Presentation submission																															1

Figure 1: Proposed schedule of paper. Highlighted tasks are critical milestones. Numbers inside of gray cells indicate the number of weeks each individual task lasts.

3.1 Same Problem but Different Solution

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4   Conclusion

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