

Initial Plan

Learning to Detect and Recognise Road Signs

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Ethics

The dataset and real-world footage used in the project are acquired from public domains and do not violate any ethical guidelines. The research done does not require ethical approval.

Project Description

The basis of this project lies on the use of artificial intelligence components being able to detect and recognize traffic signs. Its implementation can be used to improve driving experience by providing assistance to the driver and can also be applied in autonomous driving systems where live real-world traffic sign observations will need to be quickly analysed and processed in order to help the system perform the appropriate actions.

The Artificial Intelligence components used are Computer Vision systems and Machine Learning systems. Computer Vision tries to imitate the complexity of the human vision in allowing computer systems to recognize and process objects found within scenes in the same approach as humans. Since pattern recognition is the key component in the evolution of a computer vision system depends on its knowledge capacity. By “feeding” the system a very large dataset of objects to be identified we can train it to search for the patterns of those objects.

The application of machine learning will provide automation in training models with the given dataset. The system will look for patterns in the training data provided and it will learn to make more accurate decisions as more iterations are performed. This inexplicit learning procedure helps remove human intervention during the training process and creates a more efficient and effective performing system.

I will be using an existing dataset called the Mapillary Traffic Sign Dataset ^[1] which has a significant number of high-resolution images with varying parameters such as, different focal length, aspect ratios, camera noise and viewpoints. A dataset with such a wide variety of different conditioned images will provide higher confidence factor on detected objects even at harsh recorded footage conditions where it would otherwise struggle to identify the traffic signs within a scene.



Bound Box annotations using the Mapillary Traffic Sign Dataset [2]

Project Aims and Objectives

The 2 core objectives of this project are traffic sign detection and recognition with the use of artificial intelligence components. Its correct understanding and implementation will be vital in generating meaningful results.

Aims and Objectives

- Gain a greater understanding on Computer Vision systems by thorough researching object recognition algorithms from videos.
- Learn the correct practices and implementation procedures on machine learning models using training data on different object recognition problems.
- Be able to implement different approaches and performance improvements on pre-existing object detection systems.
- Develop an alternate approach on an object detection system which can be improved by creating faster and more efficient algorithm
- With the Mapillary dataset train the improved object detection model to be able to detect, recognise and categorize the traffic signs detected through the given video feed.

Time Plan

Week	Date	Milestones	Scheduled Review Meetings	Progress
1	27/01/2020 – 02/02/2020	General research on Computer Vision and Machine learning systems. Deliver project's initial plan		Completed
2	03/02/2020 – 09/02/2020	Familiarizing with object detection systems, algorithms and alternative approaches		
3	10/02/2020 - 16/02/2020	Training prototype model on traffic sign detection		
4	17/02/2020 - 23/02/2020	Improving performance on Computer Vision System and enhancing prototype		
5	24/02/2020 – 01/03/2020	Try to implement faster algorithms for more efficient road sign recognition system		
6	02/03/2020 – 08/03/2020	Create general structure of final report by adding introduction and background		
7	09/03/2020 – 15/03/2020	Perform data analysis on data gathered during the prototype's implementation phase		
8	16/03/2020 - 22/03/2020	Using data gathered create a more optimal trained model	Review Meeting	
9	23/03/2020 - 29/03/2020	Write up approach and implementation of the computer vision and machine learning systems		
Easter Break (1)	30/03/2020 – 05/04/2020	Write up the results gathered and evaluation of the implemented systems		
Easter Break (2)	06/04/2020 – 12/04/2020	Explain already existing object detection systems and its differences		
Easter Break (3)	13/04/2020 – 19/04/2020	Assess results and come up to final conclusions of the implemented system		
10	20/04/2020 – 26/04/2020	Reflect on knowledge gained while researching and developing for this project	Review Meeting	
11	27/04/2020 – 03/05/2020	Proofreading the whole report and refactoring code		
12	04/05/2020 – 07/05/2020	Revise the whole project to try and find any unseen mistakes. Deliver Final Report and Code files.		

Milestones

Week 1 - General research on Computer Vision and Machine learning systems. Deliver project's initial plan

The first week will be used to gather material and to perform general research on different Computer vision systems as well as machine learning systems by studying articles and video material that provide a detailed description on those subjects. Additionally, I will deliver the project's initial plan that has to be submitted by the 3rd Feb 2020.

Week 2 - Familiarizing with object detection systems, algorithms and alternative approaches

Researching different object detection systems such as YOLO v2 would be a great head start in understanding its way of use, its different operations and the aspects that make up system complete.

I will also research on alternative approaches for object detection such as two-stage detectors which can have the benefit of improving performance with the use of problem-specific normalization and data augmentation.

One-stage detectors such as YOLO v2 can have high accuracy but would be too slow for applications such as autonomous driving.

Week 3 - Training prototype model on traffic sign detection

With the use of the large Mapillary dataset containing the road signs I will use it as training data to create a computer vision system that is able to process, identify and recognise the traffic sign observations made through the inputted video feed that I will provide with high accuracy.

Week 4 - Improving performance on Computer Vision System and enhancing prototype

Using information gathered from previous weeks identify possible performance improvements that can be implemented to make both detection and recognition faster and more efficient.

Week 5 - Try to implement faster algorithms for more efficient road sign recognition system

By using two-stage detectors several factors can be manipulated which will increase speed and efficiency of the recognition system. For example, problem-specific normalization procedures such as cropping the detected objects of interest will prevent unnecessary slack information to be unreasonably processed.

Week 6 - Create general structure of final report by adding introduction and background

By week 6 I will have a good understanding of the several approaches for the detectors I researched. I will have already created several object detection models so I should be able to write up a clear and detailed introduction and background describing the project.

Week 7 - Perform data analysis on data gathered during the prototype's implementation phase

From the different implementation phases I should have data that can provide significant results in showing efficiency improvements and increased accuracy with the changes made on the detection algorithm.

Week 8 - Using data gathered create a more optimal trained model

By using the data analysis results gathered from week 7 I should be able to create a more optimally trained model that has every improvement aspect I will have found.

Week 9 - Write up approach and implementation of the computer vision and machine learning systems

I will use my time in week 9 to write up my approach and implementations on the different artificial intelligence systems and its uses through my object detection model. These 2 sections within my Final report will show a very detailed explanation on the algorithms I will use and the manipulated parameters that make my approach different that already existing ones.

Easter Break (Week 1) - Write up the results gathered and evaluation of the implemented systems

I will use my Easter break weeks to focus on writing up material for the Final Report. For the 1st week of the break I will focus on the results gathered on the different approaches and a complete evaluation on my implemented system.

Easter Break (Week 2) - Explain already existing object detection systems and its differences

For the 2nd week I will use it to explain pre-existing object detectors, alternative approaches for detectors such as the different one-stage detectors and the differences with my chosen two-stage detector. I should be able to clearly show the performance limitations one-stage detectors have and how they are not suitable for this kind of implementation my project suggests.

Easter Break (Week 3) - Assess results and come up to final conclusions of the implemented system

For the 3rd week I will assess the results from the different approach detectors and come up with final conclusions with my chosen implemented system.

Week 10 - Reflect on knowledge gained while researching and developing for this project

I will use this week to reflect on the knowledge I have gained while researching, studying and working during the development of my material. I will explain my understanding of the different artificial intelligence factors and its multiple uses for automating highly sophisticated computer systems.

Week 11 - Proofreading the whole report and refactoring code

By week 11 I should have a finished the Final Report and have a well-designed Program already running smoothly. I will use the time within this week to go through the Final Report to proofread it and identify any changes that need to be made in order to improve the written material. I will also go through my developed code and refactor it which will reduce its footprint but also increase performance.

Week 12 - Revise the whole project to try and find any unseen mistakes. Deliver Final Report and Code files.

For the final week which will only be able to use 3 of its days I will use this time to again thoroughly go through my work to try and find any small mistakes that I may have missed.

Then the final task milestone I need to reach is the delivery of the Project's Final Report and Code files that contain the proper explanation and implementation of the project's task for road sign detection and recognition. It will have to be submitted by the 7th May 2020 the latest.

Deliverables

A list of the deliverables that I aim to deliver by their appropriate deadlines are:

- Initial Plan
 - A general explanation of the project's aims, objectives, and work plan that will be done through the following weeks.
- Final Report
 - A thorough description, explanation, procedures and discussions on the implemented road sign detection systems. As well as a proper evaluation and conclusion section that show the results of the project's findings
- Supporting Documentations
- Code Files
 - The complete system that can perform traffic sign detection and recognition procedures on a video input. Also, a highly trained traffic sign detection model that can provide significant results with a very high confidence factor.

Supervisor Meetings

Weekly meetings have been agreed and arranged at specific times with my supervisor. These weekly meetings will give me the opportunity to discuss any problems faced through the week and keep track of my progression. If we are unable to meet in any of the weekly meetings, we will use Skype as our additional communication median.

We have also assigned 2 review meetings at weeks 8 and 10 which will make sure I am on the right track on the project's task implementation and that the deliverables are of appropriate standards.

References

- [1] Christian Ertler, (2019), The Mapillary Blog, Introducing the Mapillary Traffic Sign Dataset for Teaching Machines to Understand Traffic Signs Globally, Available at: <https://blog.mapillary.com/update/2019/06/27/mapillary-traffic-sign-dataset.html>
- [2] Christian Ertler, (2019), The Mapillary Blog, Introducing the Mapillary Traffic Sign Dataset for Teaching Machines to Understand Traffic Signs Globally, Available at: <https://blog.mapillary.com/img/2019-06-27-traffic-signs2-large.png>