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PEDESTRIANS DETECTOR

– MIRPR report –

Team members
Name, specialisation, group, email

2021-2022

Abstract

Text of abstract. Short info about:

- project relevance/importance,
- inteligent methods used for solving,
- data involved in the numerical experiments;
- conclude by the the results obtained.

Please add a graphical abstract of your work.

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Chapter 1

Introduction

1.1 What? Why? How?

There are a lot of people out there dreaming about how the future will look like, and there is a very common answer to this question: self-driving cars. Currently, the automotive industry is trying to step out of the ordinary and offer an autonomous experience to the driver. A car is equipped with lots of sensors, just like humans - it can see things, or react to them. The idea is to teach the car to make decisions based on what these sensors intercept. This paper is trying to focus on one of the many branches of autonomous driving: endowing the car with the ability of seeing.

- What is the (scientific) problem?

  An autonomous car should be able to "see" and make its own decisions based on the input. This paper aims to provide a fast and reliable computer vision solution for pedestrians detection, which is one of the most crucial aspects when it comes to self-driving cars. Using the input from the camera, any pedestrian should be detected in less than the blink of an eye, and from a considerable distance, so that the moving car gets the possibility to react smoothly.

- Why is it important?

  The goal is to get to a higher level of autonomy, but the hardest thing to do is keeping humans as safe as possible. The number of car crashes is huge every year, mostly because of lack of attention or driver's drowsiness. A machine will never get tired and this is why the automotive industry is trying to design the car to take over most of the driver's responsibilities. The thing here is that when it comes to human safety, the machine is not allowed to make mistakes, so the purpose is first of all to make these detection algorithms reach perfection.

- What is your basic approach?

  The idea is to create an intelligent algorithm that gets an image as input and outputs it with an emphasis on where the pedestrian has been detected. The algorithm should be able to provide really fast and accurate responses, therefore transfer learning techniques will also be used.

1.2 Paper structure and original contribution(s)

The research presented in this paper is focused on outlining the theory behind the TinyYoloV3 model and employing it for the particular problem of pedestrian detection in different contexts.

The main contribution of this report is to present a solution based on an intelligent classifier consisting of a pre-trained model which is run against multiple sets of data in the aim of solving the problem of pedestrian, vehicle and road sign detection.

The second contribution of this report is the development of a simple and intuitive mobile application that will present a practical user interface through which the user can easily test the algorithm results on input of their own.

The third contribution of this thesis consists of the employment of a number of optimizations with a view to increasing the overall accuracy of the algorithm and testing its performance in different scenarios.

The work is structured in seven chapters as follows:

The first chapter is a short introduction in the subject of object detection in the driving assistance field, what it is about and why it is important and our reasons that were behind choosing this topic.

The second chapter describes the scientific problem in more detai and considers the advantages and disadvantages of our aproachl.

The third chapter treats some other related work in the field and gives a brief description of their results.

In chapter four we provide the investigate approach, togheter with the tools and technologies that were used in order to implement it. We describe the underlying architecture of the TinyYoloV3 model and the algorithm employed by it, stating how we will use this for our problem and how it is suited for the driving assistance object of study. We show how the algorithm works in practice and provide a short list of the tools we will be using for our study.

Chapter five comprises the main part of this report and consists of the description of our application requirements, the methodology by which we plan to solve the problem, the datasets we will be conducting our experiments on and the results obtained in the end. At the end of the chapter, we also

provide some discussion around the results and potential optimizations to the algorithm, comparing the results obtained with the initial ones. The chapter ends with a small presentation of the user interface.

Chapter 6 explains the experimental methodology and the numerical results obtained with our approach and the state of the art approaches. Our focus in this chapter is on the interpretation and the statistical validation of the results. Also, this chapter is a dive into the philosophical aspects of autonomous driving and how this is likely to affect the way in which we report ourselves to the task of driving in general. We analyze the objectivity of the solution proposed and raise some interesting questions relating to the ethics of the smart driving assistants in general. We also provide some interesting data about the way our algorithm performs on individuals of different races and ethnicities, by this trying to advance the idea of diversity and inclusion in the way we use such technology.

The last chapter offers a summarization of our conclusions and future work and also try to analyze the strenghts and weaknesses of our application with the focus on what we can improve bpth in the algorithm and the application.

Chapter 2

Scientific Problem

2.1 Problem definition

Advanced driver-assistance systems (ADAS) are groups of electronic technologies that assist drivers in driving and parking functions. Through a safe human-machine interface, ADAS increase car and road safety. ADAS use automated technology, such as sensors and cameras, to detect nearby obstacles or driver errors, and respond accordingly.

As most road accidents occur due to human error, ADAS are developed to automate, adapt, and enhance vehicle technology for safety and better driving. ADAS are proven to reduce road fatalities by minimizing human error. Safety features are designed to avoid accidents and collisions by offering technologies that alert the driver to problems, implementing safeguards, and taking control of the vehicle if necessary. Adaptive features may automate lighting, provide adaptive cruise control, assist in avoiding collisions, incorporate satellite navigation and traffic warnings, alert drivers to possible obstacles, assist in lane departure and lane centering, provide navigational assistance through smartphones, and provide other features.

The point of this paper is to show a implies of identifying people on foot in any kind of conditions and tie this to the current climate state to propose to the client the foremost suitable activities to be taken in certain activity circumstances or to respond naturally to them.

The main advantage of an artificial intelligent algorithm is its ability to analyse and employ an enormous quantity of data, much more efficiently than possible for humans through classical statistical analyses. Moreover, the more data received, the more accurate the result will be.

The personal driving assistant would be built off an intelligent classification algorithm based on neural networks. Other methods used for obstacle detection include:

- template matching approach - the real image is compared against a sufficient number of templates

of the object-of-interest to identify the presence of the object in the sample image.

We will be using the Deep Learning approach. Our classifier will receive as input the image or video sequence and output the same image, with the obstacles marked and delimited accordingly. This should provide a good start for further improvements and additional features that would contribute to a better navigation experience in autonomous driving.

On the other hand, processing image with people is a challenge even for an intelligent algorithm. Most of the images may be difficult to read an interpret, which means that large sets of data with labeled images are required for the algorithm to work properly. Machines are still having a hard time understanding images with people and using certain unclear images can be misleading for the AI, that can provide erroneous or implausible detections.

2.2 Challenges

Much of effort was concentrated on trying to make the algorithm run faster and get a better accuracy with the amount of resources that we have had at our disposal. In trying to work with a model that is pre-trained, we have had little control over the time it takes the algorithm to do a detection. The models themselves are pretty large in size and take up a great deal of resources to run.

Lack of sufficient resources to run the algorithm was an imminent problem that we have come across.

Chapter 3

State of the art/Related work

The theory of the methods utilised until now in order to solve the given problem.

Answer the following questions for each piece of related work that addresses the same or a similar problem.

- What is their problem and method?
- How is your problem and method different?
- Why is your problem and method better?

In order to cite a given work you can use a bib file (see the example) and the *cite* command: [?], [?], [?], [?], [?].

Chapter 4

Investigated approach

Describe your approach!

Describe in reasonable detail the algorithm you are using to address this problem. A psuedocode description of the algorithm you are using is frequently useful. Trace through a concrete example, showing how your algorithm processes this example. The example should be complex enough to illustrate all of the important aspects of the problem but simple enough to be easily understood. If possible, an intuitively meaningful example is better than one with meaningless symbols.

Chapter 5

Application (numerical validation)

Explain the experimental methodology and the numerical results obtained with your approach and the state of art approache(s).

Try to perform a comparison of several approaches.

Statistical validation of the results.

5.1 Methodology

- What are criteria you are using to evaluate your method?
- What specific hypotheses does your experiment test? Describe the experimental methodology that you used.
- What are the dependent and independent variables?
- What is the training/test data that was used, and why is it realistic or interesting? Exactly what performance data did you collect and how are you presenting and analyzing it? Comparisons to competing methods that address the same problem are particularly useful.

5.2 Data

Describe the used data.

5.3 Results

Present the quantitative results of your experiments. Graphical data presentation such as graphs and histograms are frequently better than tables. What are the basic differences revealed in the data. Are

they statistically significant?

5.4 Discussion

- Is your hypothesis supported?
- What conclusions do the results support about the strengths and weaknesses of your method compared to other methods?
- How can the results be explained in terms of the underlying properties of the algorithm and/or the data.

Chapter 6

Conclusion and future work

Try to emphasise the strengths and the weaknesses of your approach. What are the major shortcomings of your current method? For each shortcoming, propose additions or enhancements that would help overcome it.

Briefly summarize the important results and conclusions presented in the paper.

- What are the most important points illustrated by your work?
- How will your results improve future research and applications in the area?

Chapter 7

Latex examples

Item example:

- content of item1
- content of item2
- content of item3

Figure example

... (see Figure 7.1)

Figure 7.1: The evolution of the swarm size during the GA generations. This results were obtained for the f_2 test function with 5 dimensions.

Table example: (see Table 7.1)

Table 7.1: The parameters of the PSO algorithm (the micro level algorithm) used to compute the fitness of a GA chromosome.

Parameter	**Value**
Number of generations	50
Number of function evaluations/generation	10
Number of dimensions of the function to be optimized	5
Learning factor c_1	2
Learning factor c_2	1.8
Inertia weight	$0.5 + \frac{rand()}{2}$

Algorithm example

... (see Algorithm 1).

Algorithm 1 SGA - Spin based Genetic AQlgorithm

```
BEGIN
@ Randomly create the initial GA population.
@ Compute the fitness of each individual.
for i=1 TO NoOfGenerations do
  for j=1 TO PopulationSize do
    p ← RandomlySelectParticleFromGrid();
    n ← RandomlySelectParticleFromNeighbors(p);
    @ Crossover(p, n, off);
    @ Compute energy ΔH
    if ΔH satisfy the Ising condition then
      @ Replace(p,off);
    end if
  end for
end for
END
```