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Artificial Intelligence for Road Safety Management:in the 21st Century

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***Abstract*—Till now many measures have been introduced to reduce road traffic accidents, but still millions of deaths occurring yearly. New methods are introduced such as Artificial intelligence (AI) application in vehicles can play an important role. To study AI's potential for road safety three applications, namely obstacle, traffic sign and cut-in detection are studied the Model. The AI behind these applications are presented to highlight how they could circumvent potential road danger. In particular the application of convolution neural networks for image analysis is studied in- depth. The shortcomings of AI are highlighted in t Autopilot crash, and simulation as an alternative to real-data collection is discussed. The essay concludes that AI will inevitably improve with developments in computing power and hardware, unsupervised learning and pattern recognition. Nevertheless, for enhanced road safety, humans need to stay alert on the road and appreciate AI as complementary support.**

***Index Terms*—Machine learning Artificial intelligence (AI) road safety**

I. INTRODUCTION

As per record , approximately 1.35 million people die due to road traffic accidents every year and about 20-50 million non-fatal injuries (WHO, 2020). All most nearly 90% of road accidents are related to human error, such as not in attention, over speeding, and improper lookout, use of GSM, eating/drinking, fatigue etc. Today many safety measures are taken in place to reduce the rate and impact of accidents, such as airbag, seatbelt, rollover protection and speeding regulations, speed regulators etc, But , one measure that could increasingly play a life-saving role, is artificial intelligence (AI) and deep learning found in autonomous vehicles.

There are 5 stages of automation At stage 5, vehicles are fully autonomous, whereas in stage 3-4 vehicles can travel fully-autonomously but require intervention in exceptional circumstances. This paper however, studies AI applications in driver-assisted and semi-autonomous cars (stage-1-2) since further autonomy stages are currently not permitted in mass- produced vehicles AI can enhance road safety and potentially safe lives in common vehicles and real-life-scenarios. The essay provides a literature review and showcases concrete examples, namely, obstacle, traffic sign, and cut-in detection. Then challenges of implementation are discussed. Lastly, the essay concludes with future directions for this topic.

Figure 1. Animal Crossing Sign Board

II. APPLICATIONS OF AI IN VEHICLES

AI is used for collision avoidance through obstacle de- tection, which can circumvent potential accidents caused by human error. The data is collected from its 8 cameras, and 12 sensors (Tesla, 2020). Unlike most partially automated vehi- cles, Tesla does not use LIDAR, which refers to light detection and ranging, and is valuable due to its depth knowledge. Instead it relies on computer vision.

The human eye immediately recognises a cows on the street. A computer, however, sees million brightness numbers in a grid of all the pixels. When CNNs initially predict the object, the connection strengths between networks are vague, and the prediction will be random. Therefore, CNN training is relevant, and to reduce the error back propagation is applied, which is an algorithm in supervised learning that can adjust the weights and biases of neural networks.

For simplicity, refer figure 2 on the following page assume this represents a deep CNN tasked with identifying a cow. The inputs, labeled 'x' arrive via a pre-connected path as highlighted by stage 1. In stage 2, the input is modeled by weights in the hidden layer. Stage 3 represents a calculation of the output for all neurons entered by the input to the output. The 4th step calculates the difference between the actual value and the desired value. Step 5 represents back propagation, whereby weights are adjusted so that the error is decreased (ibid). This supervised learning method trains the CNN, and the likelihood of detecting the cow increases.

Another example, he fleet is asked to send data of vehicles going from a right-lane to centre-lane. Such videos are au- tomatically annotated by unsupervised learning. The CNN is trained to recognise some of the patterns, for example, that the vehicle is slightly rotated before a cut-in, or the blinker is on, to predict that the car will cut-in in ‘x’ amounts of seconds. If the positive class is ‘car cuts-in from right to left’ and the

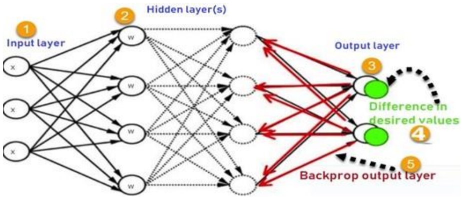

Figure 2. AI Network

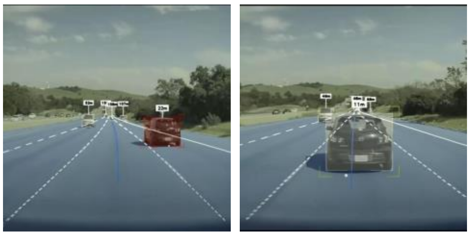

Figure 3. Car Lane changing

negative class ‘car does not cut-in from right to left’, then the ratio of false positives and false negatives must be low enoughto make accurate predictions.

III. CHALLENGES OF AI FOR ENHANCED ROAD SAFETY

For neural networks to make accurate prediction, they need a varied, well-annotated, and large amount of data-set. For example, an 80 km/h traffic sign should be fed into the CNN in various brightness levels, with obstructions such as shadows, sunny, rainy , and snow conditions. The work on traffic sign detection presented an accuracy of 0.88 and recall of 0.91, whereby recall refers to the true positives detected divided by the total true positives. In other words, from a hundred existing traffic signs, ninety-one were detected. This could be problematic as drivers set an expectation that all traffic signs will be detected although this is not the case. Similarly, this applies to object and cut-in detection. Although Tesla company employs made a shadow mode to adopt some autopilot features when the CNN is sufficiently trained, even then only sufficiency can be speak for past results and not for any future accuracy.

A fatal crash is utilizing traffic-aware cruise control sparked concerns A two-year investigation by the US National Trans- portation Safety Board (2021) concluded that the driver was on his mobile phone before the crash. Further, the car did not recognize the obstacle, which was a gore dividing one laneinto a left exit ramp and straight lane. This example highlights two main issues. First, the driver was made in attention due to autopilot, and second, the CNN in Tesla’s autopilot did not detect the gore. To circumvent this in the future, a larger data- set of gores would decrease inaccuracies in detection. Research highlights that the larger the dataset, the more accurate the algorithm.

IV. CONCLUSION

AI will enhance road safety when the driver does not become inattentive due to autonomous or partially autonomous driving. Although only driver-assisted and partially- au- tonomous vehicles are legally allowed to be sold, Google is already testing fully autonomous vehicles, and Tesla and other companies claims they have not implemented full self- driving due to legal reasons However, it may be only a matter of time until AI will playing an increasing role in road safety. Advances in CNN, computing power, unsupervised learning and pattern recognition coupled with increasingly to robust computer hardware, will improve autonomous driving. However but as highlighted by the crash with Tesla’s autopilot, AI should not be considered as a substitute for human thinking in complex situations, but rather as complementary support.

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