Giving Cars Eyes: Using Computer Vision to Prevent Road Traffic Accidents in Nigeria

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Abstract

This paper explores the application of computer vision technology as a proactive solution to prevent Road Traffic Accidents in Nigeria. By leveraging machine learning algorithms and real-time video analysis, computer vision can reduce incidents caused by human error. The research focuses on designing an autonomous but elaborate system that monitors traffic patterns, road irregularities and triggers automated interventions when risky conditions are detected. The aim is to suggest that computer vision can be pivotal in enhancing road safety and reducing traffic-related fatalities in Nigeria.

Introduction

Nigeria is the home of over 200 million people, There are over 11.8 million vehicles on the roads of Nigeria. This indicates that for every 17 Nigerians, there is approximately one vehicle (Global Status Report on Road Safety 2018). Nigeria is ranked second-highest in the rate of road accidents among 193 countries of the world (Ukoji 2014). The advancement of artificial intelligence has ushered in significant breakthroughs in human development and the preservation of life. Research in AI has led to innovative solutions for various human challenges, particularly in enhancing safety and efficiency in daily activities.

Computer vision is the science of endowing computers or other machines with vision, or the ability to see (Learned-Miller 2011). But what exactly does it mean to see? Perhaps we wish to say that vision is the interpretation of images that leads to actions or decisions, as in the navigation of an autonomous robot. Computer vision has evolved over history, developing from an idea in Larry Roberts's mind to a field in AI that is a part of our daily activities (Shapiro 2021), through Optical Character Recognition, Convoluted Neural Networks, Object tracking and detection and deep learning. Computer vision can reduce the number of Road Traffic Accidents that occur in Nigeria.

Background

AI research on autonomous vehicles has proved to be rewarding, Using computer vision algorithms and 3D modeling to enhance machines' vision was well deliberated(Janai et al. 2020).

The Middlebury flow benchmark by (Baker et al. 2011) provides sequences with non-rigid motion, synthetic sequences and a subset of the Middlebury stereo benchmark sequences (static scenes) for the evaluation of optical flow methods.

The availability of large-scale, publicly available datasets such as ImageNet (Deng et al. 2009), PASCAL VOC (Everingham et al. 2010), Microsoft COCO (Lin et al. 2014) have had a major impact on the success of deep learning in object classification, detection, and semantic segmentation tasks.

Uber Nigeria, retrofitting 3-cylinder Suzuki S-Pressos, with basic SAE level 1 requirements, like speed checkers, and cruise control, to enhance safety and cost efficiency (SAE 2018) is an example of the advancements and leaps being taken in AI application of vehicle automation to reduce RTA in Nigeria.

Approach

My approach aims at predicting steering wheel commands from a forward-looking DVS sensor mounted on a car.

The architecture of the autonomy system of self-driving cars is typically organized into two main parts: the perception system, and the decision-making system (Paden et al. 2016). The perception system is generally divided into many subsystems responsible for tasks such as autonomous car localization, static obstacle mapping, road mapping, moving obstacles detection and tracking. The decision-making system is commonly partitioned into many subsystems responsible for tasks such as route planning, path planning, behavior selection, motion planning, obstacle avoidance and control (Paden et al. 2016). Unlike conventional frame-based imagers at constant frame rates, Dynamic visual sensors produce a stream of asynchronous events at microsecond resolution in case of a brightness change surpassing a predefined threshold. This data is sparse in nature thus reducing the redundancy in transmission. (Maqueda at el. 2018).

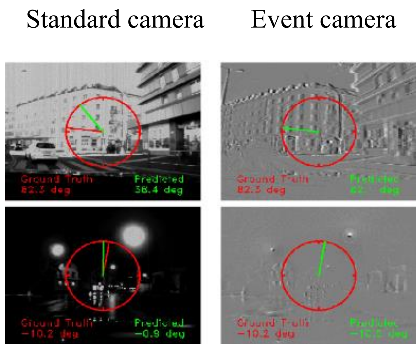

Figure 1: Steering angle regression performance.

I propose a learning approach that takes the visual information acquired by an event camera as input and outputs the vehicle's steering angle. Then, a deep neural network maps the event frames to steering angles. The neural network architecture is trained using supervised learning using datasets like DDD17 (DAVIS Driving Dataset 2017), which contains real-world driving scenarios with differences in lighting, speed, and traffic conditions. The neural network can develop precise steering predictions thanks to these datasets, which offer both the event-based visual input and the matching ground truth steering angles. Events captured by the DVS are encoded into a sparse tensor that represents the spatio-temporal distribution of pixel intensity changes. DVS sensors are often built with robust casings to protect against physical shocks, vibrations, and general wear in the temperate regions of Nigeria.

The data collected from the sensor will be stored and cross-referenced across the DDD17 datasheet. While taking note of the appropriate localization metrics like Absolute Trajectory Error (ATE) and Relative Pose Error (RPE), The ATE is calculated by representing the ground truth trajectory points and Q={q_1, q_2,…, q_N} the corresponding estimated trajectory points after alignment. The ATE can be computed as: ATE=$\sqrt{\frac{1}{N}\sum_{i=1}^{N}\|p_i - q_i\|^2}$, and RPE_{trans} = $\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left\|trans(\triangleq P_{i,k} - \triangleq Q_{i,k})\right\|^2}$.

Evaluation

Studies suggest that equipping a larger number of vehicles with SAE levels 2 (Schmittner et al. 2018) and above will reduce road traffic accidents by one-third (Insurance Institute for Highway Safety 2020). Cars driven in Nigeria tend to be on an average of SAE level 0-1. Enhancing already existing vehicles for experimental runs while taking note of the appropriate localization metrics like Absolute Trajectory Error (ATE) and Relative Pose Error (RPE) in a suburban city like Lagos would help in developing a viable datasheet that translates to the environmental factors of Nigeria, These datasheets will serve as the groundwork to make the streets and highways safer for both pedestrians and drivers.

This research is as important to me as anyone else in Nigeria concerned for the reduction in fatalities by road traffic accidents.

Discussion

The expected implications for AI if my research is successful is the massive spread and development of AI in Africa, Nigeria being the most populated country in Africa has little knowledge and data on AI. I hope to inspire more like minds and save the lives of countless people by my approach while also gathering data to help the next researcher build an even better safer Nigeria.

Conclusion

The study shows how computer vision has a great deal of promise to lower Road Traffic Accidents and advance artificial intelligence (AI) in Nigeria. By integrating dynamic vision sensors and deep neural networks, the suggested system may give real-time hazard identification and proactive steering assistance. This lays the groundwork for data-driven traffic safety solutions in addition to addressing the problems caused by Nigeria's poor road conditions. While spurring additional advancements in vehicle safety throughout the continent.

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