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AUTONOMOUS SMART VEHICLE SYSTEM USING OPENCV

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Abstract: **We study the significance of artificial intelligence (AI) as machine learning, deep learning, and data mining in self- driving vehicle research and development as assessed by patents and articles through an analysis of quantitative scientific evidence. Self-driving automobiles are achieved via artificial intelligence systems. They enable a vehicle to gather data from camera systems and other sensors about its surroundings, evaluate them, and determine what steps to take. It used a sophisticated algorithm. Certain autonomous self- driving vehicles ought to be able to detect road markings distinguishing yellow lines and white lines. Create a straightforward pipeline using OpenCV to locate lane lines in an image, then apply it to a full video feed. A key component of cutting-edge driver assistance systems that improves road safety is traffic sign recognition (TSR). Computer vision methods, which are important to the study of pattern recognition in general, are devoted to the development of TSR systems. Traffic sign detection and recognition remain a very challenging task even after all the previous studies and efforts, particularly if we want to offer a real-time processing solution. The method relies on fast region-based convolutional neural networks, while the other method is based on colour segmentation and deep convolutional neural networks. The principle of "Real-Time Vehicle Detection and Tracking" (RT VDT) refers to a sophisticated and resourceful vehicle detection and tracking method that has been outlined and put into practice. This works well for applications involving self-driving cars (SDC) or advanced driving assistance systems (ADAS). The RT VDT primarily consists of a pipeline of trustworthy computer vision algorithms that complement one another and accept unprocessed RGB pictures. To provide output that is as precise as feasible, several of the used algorithms are also functioning in parallel to enhance one another. In actual videos, the performance of the entire pipeline is also tested. The analysis of the suggested method demonstrates that it reliably identifies and tracks vehicle boundaries in a range of circumstances. Also highlighted are the benefits and drawbacks of the suggested method. A PID controller allows you to control how smoothly an application follows a value or a path. This described how the system steers a car along a predetermined course. The most precise and reliable controllers are proportional integral derivatives, which use a control loop feedback mechanism to control process variables. The use of self-driving hybrid vehicles is expanding and transforming society. Model-free or model- based algorithms can serve as the foundation for controllers for autonomous vehicles and driver assistance systems. Fuzzy logic, neural networks, artificial intelligence (AI), and haptic- based virtual and augmented reality are mostly used to construct the feedback error and the control action for model predictive controllers. Detecting new roads and patterns is usually done using road detection and segmentation, which is a crucial component of navigation systems. Its primary objective is to give autonomous car and robot navigation. We can locate the right roadway where the vehicle can move as supportive vehicles with the use of road identification and segmentation, preventing any collisions with on-road obstructions. This paper proposes a novel method for OpenCV-based road recognition and segmentation (Open- Source Computer Vision Library). In essence, OpenCV is a library of functions designed to offer real-time computer vision. It consists of several techniques by which an autonomous car can find obstacles on the road and drive around them.**

Keywords: **OpenCV, Deep Learning, Hough Transforms, Canny Edge Detection, Semantic Segmentation, MPC & PID Controller.**

I. INTRODUCTION TO MACHINE LEARNING (ML)

An algorithm and a statistical model are both utilised to create a powerful model that can complete several tasks by utilising patterns and inference. Machine learning is sometimes described as a subset of artificial intelligence. Data is subjected to machine learning algorithms, which aid in the creation of a mathematical model. when a model-based prediction or judgement is produced using machine learning techniques. For many applications, like email filtering and computer vision, a straightforward method is either impractical or perhaps impossible. Computers are used to calculate computational statistics. Machine learning may learn about theory, application areas, and techniques through the study of mathematical optimization. Using algorithms to search through vast datasets for hidden

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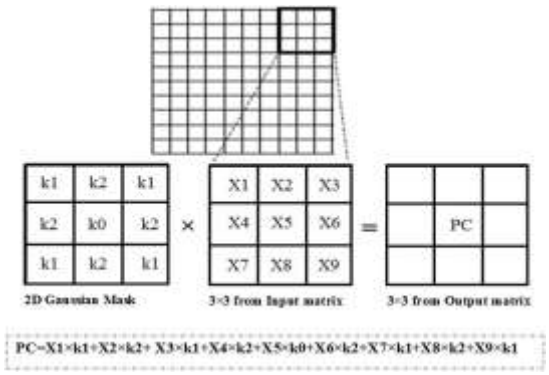
patterns enables the unsupervised learning approach. If predictive analytics interests you, you could hear machine learning referred to as predictive analytics. The term "name machine learning," originally used in a 1959 publication, was created by Art Samuel. You can believe it when you see it, according to Tom Mitchell's informal definition of algorithms. By examining a certain category of activities (like a job) and gauging their success, they contend that computer software may learn from earlier experiences (such as overall productivity). This study classifies the fundamental building elements of the subject rather than disputing whether machine learning includes cognitive qualities. Can robots hold similar views to humans? What is feasible for humans as cognitive creatures are also achievable for robots. Turing advocated for giving computers the same freedom and latitude that people do when it comes to how they express themselves and how their traits affect how they evolve.

OpenCV for Lane Lines Detection System

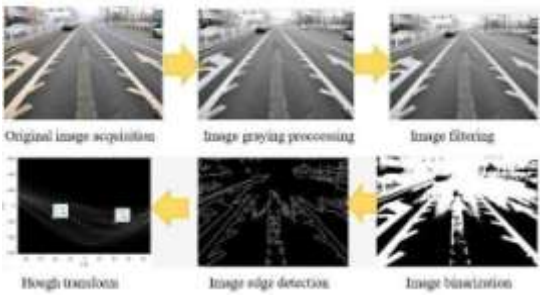
In this, we use some software that we are currently developing to find the lane lines on the road. The ability to recognise and follow lanes is essential for creating algorithms for autonomous vehicles.

$$Edge\_Gradient\ (G) = \sqrt{G_x^2 + G_y^2}$$

$$Angle\ (\theta) = \tan^{-1}\left(\frac{G_y}{G_x}\right)$$



Images are transformed from RGB to grayscale because processing a single channel image is quicker than.

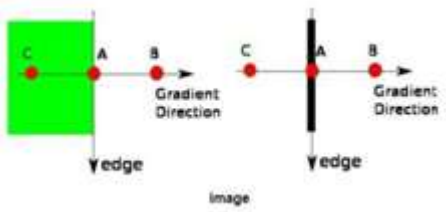


Canny Edge Detector

The Canny Edge Detector tracks the edges with significant variations in intensity by computing gradients in all directions of our blurred image. We'll examine its application. Our input image is the first argument. Our minVal and maxVal are the second and third arguments, respectively. Aperture size is the fourth argument. The Sobel kernel's size is what is used to find image gradients. It is 3 by default. L2gradient, the final argument, contains the equation for calculating gradient magnitude.

Edge Gradient(G)=|Gx|+|Gy| is the function that is used if the condition is True since it is more accurate than the previously described equation. It is False by default. At this stage, it is determined which edges are actually edges and which ones are not. We require the threshold values minVal and maxVal for this. Any edges with gradients of intensity more than maxVal are certain to be edges, and any below minVal are certain to be non-edges, so they should be disregarded.

Based on their connectedness, those who fall between these two thresholds are categorised as edges or non-edges. They are regarded as being a part of edges if they are linked to "sure-edge" pixels. If not, they are likewise thrown away. Since edge A is over maxVal, it is regarded as a "sure-edge.



" The whole curve is obtained even though edge C is below

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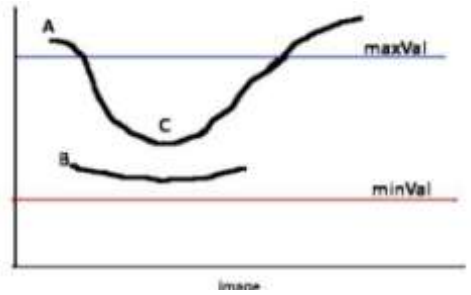
maxVal since it connects to edge A, which is likewise regarded as a legitimate edge. Although edge B is in the same region as edge C and is above minVal, it is not related to any other "sure-edges" and is therefore disregarded. Therefore, it is crucial that we choose minVal and maxVal appropriately in order to obtain the desired outcome.

Hough Line Transform

The Hough Line Transform is a transform that is used to find straight lines. Here, the probabilistic Hough Line Transform is utilised, and the output is represented by the identified lines' extremes. It is used for the advanced lane finding algorithm. In our discriminative Hough transform-based object detector, each local component weighs its vote for potential locations for the object centre. We demonstrate that learning weights in a max-margin framework that directly improves classification performance is possible. The codebook appearance and the spatial distribution of its position relative to the object centre are both taken into consideration by the discriminative training to determine its relevance. We demonstrate that the discriminative training enhances the Hough detector using various datasets. Our method significantly outperforms the state of the art, achieving a detection rate of 91.9 percent at 0.3 false positives per image on the ETHZ shape dataset when combined with a verification phase using an SVM-based classifier.

Histograms using a Colour Gradient

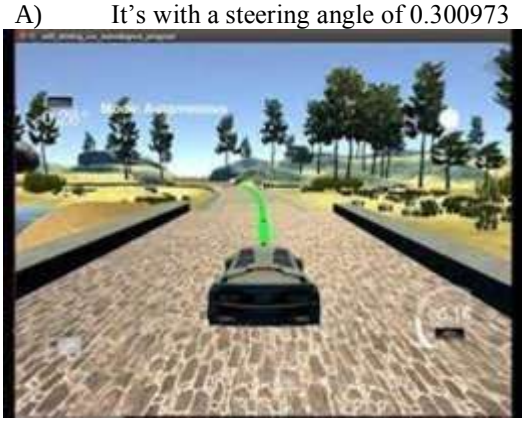
In this research, a brand-new method for recognising handwritten characters is put forth that makes use of multi-resolution histograms of oriented gradients (MHOG). Multi-resolution oriented gradient histograms are combined with canonical correlation analysis (CCA). Three handwritten character databases were used to test the system, and the results showed that it was effective.



Behaviour Cloning

The goal of the project was to train a Deep Network to replicate the human steering behaviour while driving, thus being able to drive autonomously. Here is an example of a typical sample. Three frames from various cameras are available, along with the corresponding steering angle. To begin with, each picture is pre-processed by cutting the upper and bottom portions of the frame; this allows us to remove data that is likely pointless for determining the steering direction. Currently, our input frames like these.

A) It's with a steering angle of 0.300973



B) It's with a steering angle of 0.000000

Deep Neural Networks

Deep neural networks (DNNs) have impressed researchers with their performance in challenging machine learning tasks like voice or picture categorization. However, because of their multilayer nonlinear nature, they are not transparent; that is, it is challenging to understand how they classify or recognise a fresh unknown data sample. Recently, several methods have been put out that allow one to comprehend and analyse the logic contained in a DNN for a single test image. These techniques provide visualisation in the form of a heatmap in pixel/input space and quantify the "value" of individual pixels concerning the classification decision. Heatmaps' usefulness can be evaluated subjectively by a human, but there is no objective standard for measuring quality.

In this research, we provide a universal method for assessing ordered pixel collections like heat maps that are based on region perturbation. On the SUN397, ILSVRC2012, and MIT Places data sets, we compare heat maps generated using three distinct approaches. Our key finding is that, compared to the sensitivity-based technique or the deconvolution method, the recently suggested layer-wise relevance propagation algorithm qualitatively and quantitatively offers a superior explanation of how a DNN came to a given classification conclusion. To clarify this finding and illustrate its practical ramifications, we offer

theoretical justifications. Finally, we look into the usage of heat maps to evaluate neural network performance unsupervised.

PID Controller

In this paper, a PID controller is used to maintain vehicle alignment by suitably altering the steering angle. The most common types of controllers are PID (proportional integral derivative) controllers. This controller is employed by the majority of process industries. Because of its simple structure, near-optimal performance, and reputation for dependability, it is used. But the PID controller needs to be calibrated correctly. PID can be tuned offline using a variety of techniques, however due to parameter volatility and system disruptions, it becomes necessary to tune these controller parameters online. This study examines the fuzzy supervised PID controller with online PID parameter tuning. Additionally, by utilising the Ant Colony Algorithm, the parameters of the fuzzy supervised PID have been optimised. Based on how well each controller performs when a system is subjected to parameter changes, ideally offline adjusted PID and fuzzy supervised PID have been compared for robustness. As a result of these findings, it is discovered that using both controllers together perform better than using each controller separately. The Magnetic levitation system has finally been equipped with an optimally offline adjusted PID and a combination of the two controllers, and the results gained from it also support this.

MPC Controller

A sophisticated approach to process control, model predictive control (MPC) depends on dynamic models of the process. In contrast to PID controllers that have traditionally been used, MPC controllers can predict future events and adjust control actions accordingly. In fact, future time steps are considered when maximising the current time slot. MPC predicts plant outputs in the future using a model of the plant. In order to determine the best control action that brings the anticipated plant output as closely as feasible to the intended reference, it solves an optimization problem at each time step. A sophisticated form of process control called model predictive control (MPC) is used to manage a process while adhering to a set of restrictions. Since the 1980s, it has been utilised in chemical and oil refineries as well as process industries.

Path and Road Segmentation

Semantic segmentation is a deep learning approach that associates a label or category with each pixel in an image. Semantic segmentation refers to providing a class label to each pixel in the provided image. It is used to identify groups of pixels that represent various categories. An autonomous vehicle, for instance, needs to recognise other cars, pedestrians, traffic signs, pavement, and other elements of the road. This helps in our objective in this project to carefully navigate a virtual highway while sharing the road with other vehicles that are moving at the posted speed limit. The car's localization and sensor fusion data will be made available to you, along with a scant map list of waypoints along the highway. When possible, the driver should pass slower traffic to keep as close to the speed limit as practicable; nevertheless, other vehicles may also attempt lane changes. At all costs, the car must avoid colliding with other vehicles and stay inside the indicated lanes of the road, unless it is changing lanes. The vehicle ought to be able to circle the roadway once in its entirety.

II. CONCLUSION

This study is concerned with the application of automated safety features in self-driving automobiles to replace driver assistance when navigating roads and the integration of several AI and machine learning technologies. To run and operate an autonomous vehicle, a combination of sensors, software, radar, wireless signals, and cameras analyse the road conditions.

III. REFERENCE

[1] Hinton, G.E., Krizhevsky, A., Srivastava, N., Sutskever, I., & Salakhutdinov, R. (2014). - Dropout :A simple way to prevent neural networks from overfitting. Journal of Machine Learning Research, 15, 1929-1958. (pg : 142 , CV: 536). .

[2] Lapedriza, À., Oliva, A., Torralba, A., Xiao, J., & Zhou, B. (2014). - Learning Deep Features for Scene Recognition using Places Database. NIPS. (pg : 65 , CV:476)

[3] Fei-Fei, L., Karpathy, A., Leung, T., Shetty, S., Sukthankar, R., & Toderici, G. (2014). IEEE Conference on Computer Vision and Pattern Recognition - Large- Scale Video Classification with Convolutional Neural Networks(cited 865 times, pg : 24 , CV: 239)

[4] He, K., Ren, S., Sun, J., & Zhang, X. (2016). CoRR, abs/1512.03385. - Deep Residual Learning for Image Recognition, ”(cited 1436 times, pg : 137 , CV: 582).

[5] Bengio, Y., Courville, A.C., Goodfellow, I.J., Mirza, M., Ozair, S., Pouget-Abadie, J., Warde-Farley, D., & Xu, B. (2014) NIPS. - Generative adversarial nets,”(cited 463 times, pg: 55 , CV: 0)

[6] Batista, J., Caseiro, R., Henriques, J.F., & Martins, P. (2015). -High-Speed Tracking with KernelizedCorrelation Filters CoRR, abs/1404.7584. (cited 439 times, pg: 43 , CV: 0)

[7] Zhang, M., & Zhou, Z. (2014). IEEE TKDE ,-A Reviewon Multi-Label Learning Algorithms(cited 436 times, PG: 7 , CV: 91)

[8] Batista, J., Caseiro, R., Henriques, J.F., & Martins, P. (2015). - High-Speed Tracking with Kernelized CorrelationFilters”CoRR, abs/1404.7584. (cited 439

times, pg : 43 , CV: 0)

[9] Amorim, D.G., Barro, S., Cernadas, E., & Delgado, M.F. (2014). Journal of Machine Learning Research "Do weneed hundreds of classifiers to solve real worldclassification problems" (cited 387 times, pg : 3 , CV: 0)

[10] Dong, X., Gabrilovich, E., Heitz, G., Horn, W., Lao, N., Murphy, K., ... & Zhang, W. (2014, August). In Proceedings of the 20th ACM SIGKDD international conference on Knowledge discovery and data mining ACM. - Knowledge vault: a web-scale approach toprobabilistic knowledge fusion "(cited 334 times, pg : 7 , CV: 107).

[11] Lowe, D.G., & Muja, M. (2014). IEEE Trans. Pattern Anal. Mach. Intell., -Scalable Nearest NeighborAlgorithms for High Dimensional Data," (cited 324 times, pg: 11 , CV: 69).

[12] SYED FAWAD HUSSAIN1, SYED IMTIYAZ HUSSAIN2,, MEHROZ ALI ANSARI4, - FACE RECOGNITION-BASED ATTENDANCE SYSTEM USING OPENCV (CNN)"C:2021 JETIR June 2021, Volume 8, Issue 6 www.jetir.org (ISSN-2349-5162)(pg: 1-8)

[13] Shreyamsh Kamate, UAV (2015): - Application of Object Detection and Tracking Techniques for Unmanned Aerial Vehicles, Texas A&M University,(pg : 134, CV: 189)

[14] Mohana and H.V.R. Aradhya (2016), - "Elegant and efficient algorithms for real time object detection counting and classification for video surveillance applications from single fixed camera", 2016 International Conference on Circuits Controls Communications and Computing (14C), pg. 1-7,

[15] Arbeláez, P.A., Girshick, R.B., Hariharan, B., & Malik, J. (2014) ECCV ," Simultaneous Detection andSegmentation," (cited 286 times, pg: 23 , CV: 94)