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A Study on Autonomous Driving Adaptive Simulation System Using Deep Learning Model Yolov3

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Abstract—For the safety of autonomous vehicles, it is not necessary that the human driver does not have much trouble detecting other vehicles and maintaining a certain distance between them, but in the case of autonomous vehicles, that's not an easy task. The problem of detecting and recognizing the front state of autonomous vehicles is known as object detection by Yolov3 bounding boxes. Therefore, we propose this study to avoid accidents before they occur due to autonomous driving on the road and for a better future. Our purpose in this study is to put autonomous vehicles on the road in practice using Simulink Matlab, and it is a reflection on the ability of autonomous vehicles to ensure curve road safety And to quickly determine responses on curve road situations such as acceleration/deceleration, stopping, and keeping the same speed direction so that better decisions can be made quickly. Simulation represents a possible solution by enabling the creation of reliable bounding boxes, as a first step, in this study, we discuss the feasibility of a simulation framework to detect the speed of different autonomous vehicles using Yolov3 in the real world. We first developed the YOLOV3 algorithm for autonomous vehicle image recognition using the dataset from the Matlab site. The YOLO v3 model, with an optimal performance compared to the performances of deep learning algorithms, is applied. The training parameters are refined through experiments and in the second part we proposed an effective system using "Vision Vehicle Detector test brake adapter" adaptive HighwayLaneFollowingTestBench/Simulation 3D Scenario to prepare Matlab Simulink simulation environment and sensors, Vision Vehicle Detector. The training parameters are refined through experiments. The vehicle detection rate is approximately 95.8% As per our best knowledge, as a result of the experiment, the proposed system has shown favorable results.

Keywords/Index Terms—Deep Learning, Vehicle Detection, Object detection Yolov3, Curve Road, Matlab-Simulink.

1. Introduction

To obey traffic rules, they must recognize cars, pedestrians, and road signs. While it does not take much effort for human drivers to recognize an appropriate road sign or another car, it is not an easy task for autonomous vehicles to do so [1]. According to today's research and development, it is unclear how these technologies will be able to handle extreme and unexpected events. We can estimate that in 2030 a significant number of driverless vehicles will travel on the roads. There is a concern over the development of several different technologies that will result in very different products, which in some situations will not be able to work together and communicate with each other. There are trends that rely solely on the signs of sensors in the car, others need infrastructure improvements that help decision making. As the cause of most traffic accidents is human error or omission, it is anticipated that the emergence of autonomous technologies will reduce the number of car accidents. There is not enough statistical data to sustain this statement yet [2].

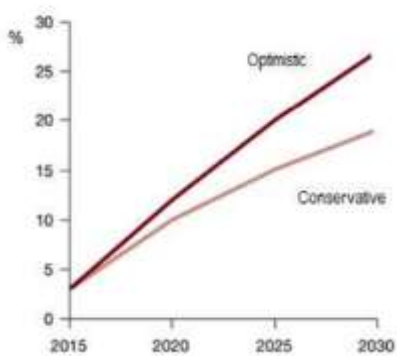


Figure 1. Autonomous Driving in the market

Phishing The optimistic scenario takes account of less restrictive safety regulation, more pork barrels, the appearance of new market players And the conservative scenario assumes that the current situation will not change. Using deep learning and YOLOv3 the vehicles detection has been carried out for the analyzed highway segment[3].

Table 1. Comparison of our system related survey Papers

Related Work	Survey Coverage					
	Connected System	Deep Learning Support	Detection Yolov3	Implementation	Simulations	Software Simulink-Mat lab
[1]	-	-	✓	-	-	-
[2]	-	✓	-	-	-	-
[3]	✓	✓	-	✓	-	-
[4]	✓	-	✓	✓	-	-
[5]	-	-	-	-	✓	-
Ours	✓	✓	✓	✓	✓	✓

This study is intended to propose a structured and comprehensive overview of the software practices and connected systems are discussed in detail in Table1. There are general Papers on the subject, which covered several central functions [1], [2], and which focused only on the planning aspect of the movement [3], [4]. However, no survey covers current challenges, available system architectures, individual basic functions such as location, detection, planning, detection, vehicle control.

Figure 2. AI, Machine Learning and Deep learning

The figure 2 presented the difference as Artificial Intelligence is a program that

allows you to feel, reason, act and adapt. Machine learning is algorithms whose performance improves as more data is exposed over time. Deep learning is a subset of machine learning in which multilayer neural networks learn from large amounts of data [5].

Figure 3. Six levels of autonomous vehicles (Driving)

learning Levels of autonomous vehicles to drive have diversified in recent years, including adaptive cruise control, environmental sensing, and other advanced driver assistance systems, which have become increasingly common. This made it possible to clearly measure autonomous driving technology on a scale. There are six levels of range to drive. Here's how each of the six levels works. Level 0 Autonomous Vehicle, Level 1 Autonomous Vehicle, Level 2 Autonomous Vehicle, Level 3 Autonomous Vehicle, Level 4 Autonomous Vehicle, and Level 5 Autonomous Vehicle, as shown in Figure 3.

The main goal of this study is to ensure a better future that can save lives in the event of an accident due to autonomous driving on the curve road.

The paper is structured as follows: Section 1provides the background and motivation and Objectives of this article. Section 2describes related works for text categorization. Section 3 presented the Overall Architecture of Autonomous Vehicle Detection System Applying 'improve Yolov3". Section 4 proposed the Method and Design Phase of this paper. Section 5 illustrated Evaluation, Execution. And experimental results and Section 6 concludes the paper with suggestions for further research.

1.1 Statement of the Problem

The problem of detecting autonomous vehicles and recognizing their state is known as Traffic Lane Object Detection by the Yolov3 bounding box. The number of injuries is the number of people has increased due to an increase in the number of road accidents over the past four years. Furthermore, according to the analysis of the types of road accidents in the period 2015 to 2019 in Figure 3, the percentage of vehicle-to-vehicle road accidents was more than 88%, Figures 4 and 5 show diagrams demonstrating the violation of traffic regulations. About 60% of road traffic accidents in the past five years are due to negligence, while 25% of accidents were caused by failure to maintain a safe distance between vehicles

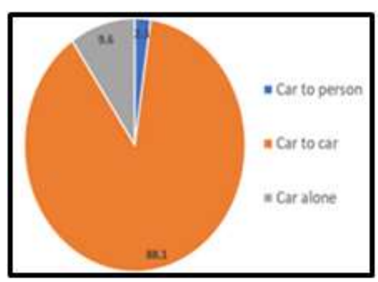


Figure 4. Current status of traffic accidents over the past five years according to the accident type s

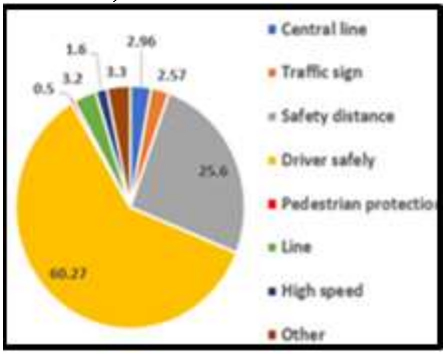


Figure 5. Traffic accidents in the past five years

1.2 Our Motivation

Our system has complete control of the vehicle's steering and possibly the Break or keeping the same speed direction so that better decisions can be made quickly and replace human intervention in these activities. The text in the object to proposed the new Yolov3 and applied by analyzing Highway Lane Following Test Bench/Simulation 3D Scenario to prepare Matlab Simulink simulation environment and sensors, Vision Vehicle Detector.

1.3 Goal and Objectives

In this study, our objective is to study a novel approach to autonomous driving systems by applying deep learning algorithms to implement a newly activated autonomous driving system for vehicles and simulate it in Simulink-Matlab. Our proposal method helps autonomous driving to be able to collect information from outside the car through a real-time camera and make a decision in a short time. And to quickly determine responses such as braking or lane-keeping, better decisions can be made quickly. The main objective of this study is to ensure a better future that can save lives in the event of an accident due to autonomous driving on the road. First, we implemented the YOLOV3 algorithm for recognizing images of autonomous vehicles using the dataset from the Matlab site. The Vehicle Recognition System uses Yolov3 to develop autonomous driving suitable for a vision vehicle using Deep Learning, based on the number of vehicles detected.

1.4 Utilization

In The autonomous track environment system in this study uses a bounding box through the simulation system. And our system first detects the autonomous vehicle and tries to hide the car named "A Car" in the simulation. We use Yolov3 to detect bounding boxes, detection is performed on a curve road as follows when the YOLOV3 algorithm detects vehicles ahead and excludes "A Car" vehicles outside the centerline - red line. Assuming the current time is T, the difference between a point in the bounding box of T objects and a point in the bounding box at T + 1 is compared to 0 means comparing the displayed bounding box with the previous frame and if it is big than 0, a safety situation is detected. Thus the autonomous vehicle sends a signal indicating a safety situation to be driven and steered in order to control it while maintaining/keeping the same speed. If it is less than 0, a dangerous situation is detected and the autonomous vehicle sends a signal indicating a dangerous situation to drive and steer in order to control it following the pause/break.

1.5 SWOT Analysis of System

The opportunities of our project help to Save and ensure the safety of autonomous vehicles and we can find in Fig 6. The strengths add continuous software model improvement because our system produces in real-time prediction function.

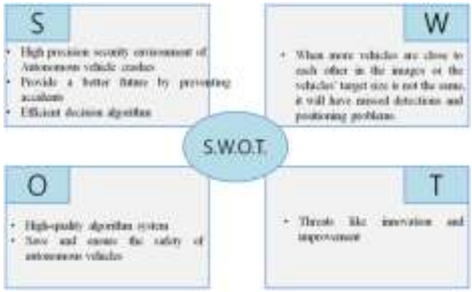


Figure 6. SWOT Analysis of System

2. Overall Architecture of Autonomous Driving using Deep learning Model Yolov3

2.1 System Architecture

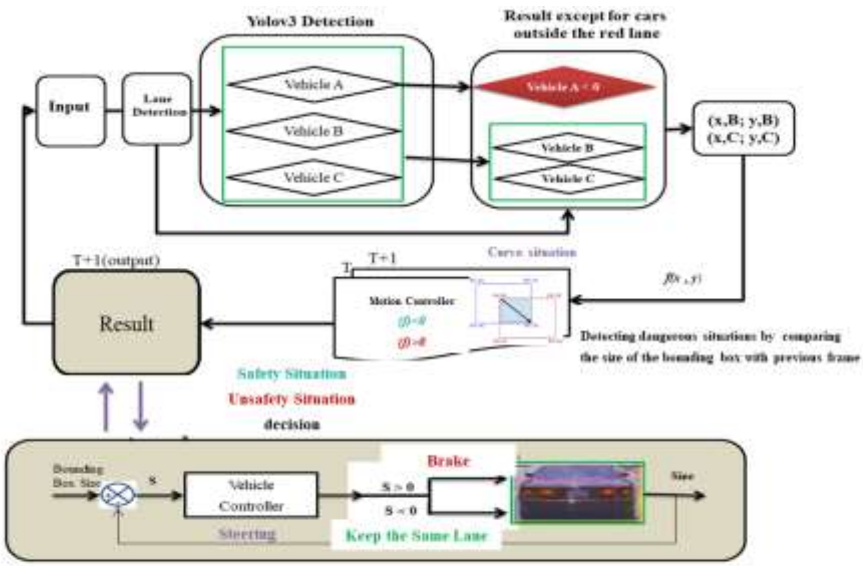


Figure 4. Fig.7 Overall Architecture Proposed System.

Our system in Figure 7 solves current problems such as 1) There is no single best effective security for track safety detection and processing. 2) There is no Yolov3 developed and it is applied directly to your system to detect in real-time 3) There is no algorithm capable of collecting information from outside the car through a camera in real-time and making a decision in a short time 4) There is no system that can quickly determine responses such as acceleration/deceleration, stopping and avoiding, so that better decisions can be taken quickly.

2.2 How the System is Work?

The autonomous vehicle system of this study uses a bounding box by the simulation system and our system detects the autonomous vehicle tries to hid or mask the car named "A Car" in the simulation. We use Yolov3 to detect bounding boxes. When an input image comes in, the architecture system first finds the centerline. Then, the improved Yolov3 algorithm detects the vehicles ahead and excludes the "A Car" vehicles outside the center lane. In other words, by comparing the size of the bounding boxes of the vehicles detected, we used our proposed computational method to detect the vehicle ahead in curve road situation using Yolov3 to detect bounding boxes, detection is performed on a curve road as follows when the YOLOV3 algorithm detects vehicles ahead and excludes "A Car" vehicles outside the centerline - red line. Assuming the current time is T, the difference between a point in the bounding box of T objects and a point in the bounding box at T + 1 is compared to 0 means comparing the displayed bounding box with the previous frame and if it is big than 0, a safety situation is detected. Thus the autonomous vehicle sends a signal indicating a safety situation to be driven and steered in order to control it while maintaining/keeping the same speed. If it is less than 0, a dangerous situation is detected and the autonomous vehicle sends a signal indicating a dangerous situation to drive and steer in order to control it following the pause/break.

2.3 Use Case Diagram

Use Case Diagram Autonomous Vehicle shows the integrated entity management and an Autonomous driving system operating conditions center to the recessive execution provider system; Provide various additional perceptions in driving mode(Fig 8).[11]

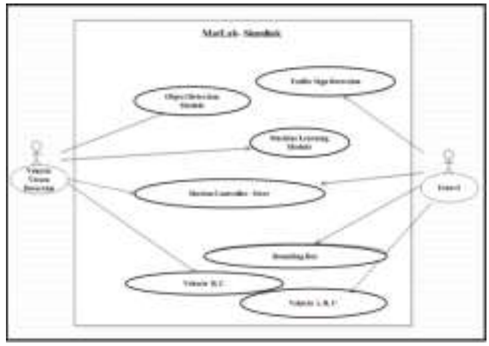


Figure 8. Use Case Diagram of Vehicle detection

the attackers. Phishers study their victims to know the sites they visit regularly and ensure to contact these victims stating the need for them to change their passwords as their account could be blocked or disabled. The victims who want to preserve their accounts, will go ahead and change their password or login details, providing access for the attack. Due to this danger, a lot of individuals and companies have lost valuable information and a lot of money (Nureni and Irwin ,2010).

Because the victims do not notice the minute details that differentiate these sites from the legitimate ones, they fall.

2.4 Class Diagram

The class diagram introduces an Autonomous driving system operating conditions by analyzing the Module controller and connecting it via system operating to Safety Situation Unsafety Situation decision as shown in fig. 9. [12]

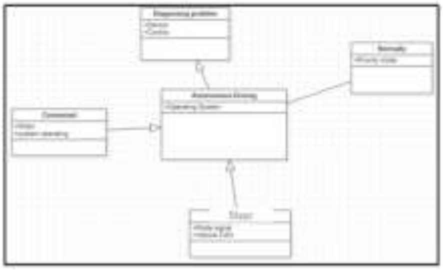


Figure 9. Class Diagram of Vehicle vision detection

2.4 Sequence Diagram

Sequence Diagram Autonomous vehicle system limits present signal indicating a dangerous situation to drive and steer in order to control it only breaking required after a dangerous situation is detected. And it shows how the labeling is connected to the autonomous deep learning model Yolov3 and the Vehicle vision detector as shown in fig.10

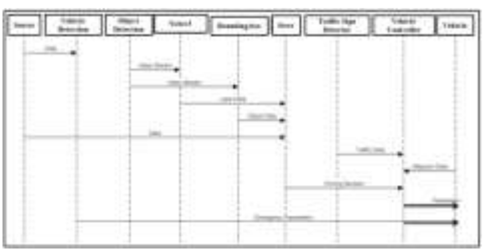


Figure 10. Sequence Diagram of Vision detection

3. Method and Design Phase

3.1 Design - Propose Method Yolov3

Machine YOLO v3 object detection network was designed as follows Fig11; Start the model with a feature extraction network, Create detection subnetworks by using convolution, batch normalization, and ReLu layers and the output layers that connect as inputs to the detection sub-networks are the detection network source [13].

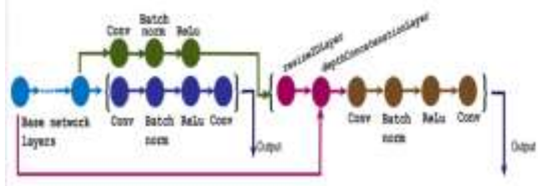


Figure 11. Yolov3

Table 2. Yolov3 Object detector

Description	- Create a pre-trained YOLO v3 object detector by using YOLO v3 deep learning networks trained on the COCO dataset. - Create a custom YOLO v3 object detector by using any pretrained.	
Syntax	detector = yolov3ObjectDetector(name) detector = yolov3ObjectDetector(name,classes,aboxes) detector = yolov3ObjectDetector(net,classes,aboxes) detector = yolov3ObjectDetector(baseNet,classes,aboxes,'DetectionNetworkSource',layer)	
Input Arguments	name 'tiny-yolov3-coco' Name of pre-trained YOLO v3 deep learning network 'darknet53-coco' | 'tiny-yolov3-coco'	
Object Functions	detect	Detect objects using YOLO v3 object detector
	preprocess	Preprocess training and test images
	forward	Compute YOLO v3 deep learning network output for training
	predict	Compute YOLO v3 deep learning network outputs for inference

Training: We refer to Table 2 and use a coconut dataset from the Matlab website, which corresponds to "box labels" in each new image. We do not apply the classification method to use the trained model first, but we have chosen the example from the Matlab site to verify the results of "image + box labels" during the implementation phase. Then we execute the code modifying the activation of the directory given in the code. Our result shows that the consistency check was excellent with a precision greater than 0.8. We have added more than 80 epochs to ensure the accuracy of the drive status.

3.2 Data Gathering System Design of Vision Vehicle Detector test bench adaptiveHighwayLaneFollowingTestBench/Simulation 3D Scenario

3.2.1Vision Vehicle Detector

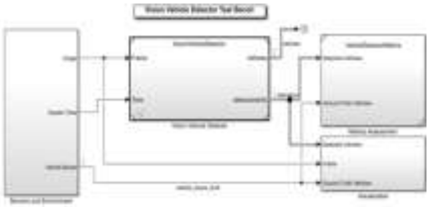


Figure 12. Test Bench Configuration

Figure 13. VisionVehicleDetector

We apply Vision Vehicle Detector in our system to test a monocular camera-based vehicle detector Fig.12 and generate deployable code for real-time applications on a pre-defined 3D scene. It works in the following way: 1) Design the test bench model to verify the functionality of a vehicle detector based on a monocular camera using ground truth information. 2) Simulate the dyno model with ACF and YOLOv3 based vehicle detectors and compare performance. A Vision vehicle detector is a fundamental perception component of an automated driving application.
open_system("VisionVehicleDetector");
(Fig.13) .

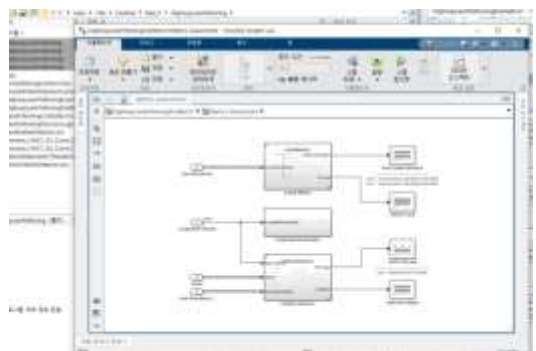
3.3 Sequence Diagram

Here we present how to simulate a freeway lane tracking application in our system with vision processing, sensor fusion, and controller components. These components are tested in a 3D simulation environment that includes models of sensors, cameras, and radars. We adapt it to a highway lane departure system that steers a vehicle to travel in a marked lane because it is at a safe distance from a previous vehicle in the same lane and maintains a safe speed or distance. [14].

Figure14. HighwayLaneFollowingTestBench

3.4 Proposed Calculation Method of the Bounding Box

In this subchapter, we proposed methods using a bounding box to detect the danger



according to the distance between vehicles when the detection is performed on a curve road.

3.4 Detection is performed on a curve road

The detection is performed on a curve road as followed Fig.15, when our “improve YOLOV3” algorithm detects the vehicles ahead and excludes the "A Car" vehicles outside the centerline - red line.

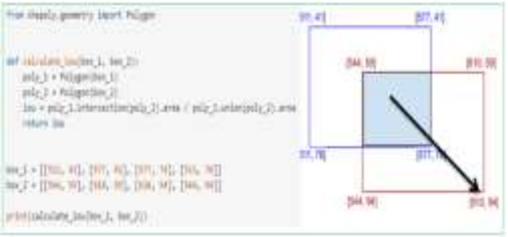


Figure 15. Bounding box result on Curve road situation

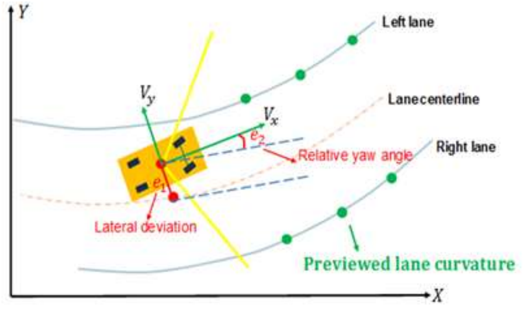


Figure 16. The situation where detection is performed on a curved road.

Assuming that the current time is T, the difference between a point in the bounding box of the objects at T and a point in the bounding box at T+1 is calculated to get a center point between two bounding boxes. When we got two-point between two bounding boxes respectively, we can apply or find a Vector as shown in the figure to predict the movement of the vehicle on a curve road. And then compared the displayed bounding box with the previous frame.

And then we can apply our method by comparing it to 0, which means comparing the displayed bounding box with the previous frame and if it is big than 0, a safety situation is detected. Thus the autonomous vehicle sends a signal indicating a safety situation to be driven and steered in order to control it while maintaining/keeping the same speed. If it is less than 0, a dangerous situation is detected and the autonomous vehicle sends a signal indicating a dangerous situation to drive and steer in order to control it following the pause/break.

4. Implementation & Experimental and Simulation Result

4.1 System Requirements

We are preparing a Vision Vehicle Detection models benching to run in the Simulink experimentation environment. Our model has already been trained and all references are published on the Matlab site. We collected the information. We change the scenario and it is separately simulated lane detection and vision vehicle detection using Yolov3.

The deep learning algorithm YOLOv3 was implemented in Matlab to perform deep learning operations in C language, and the experimental scene in a virtual roadway environment was implemented in C using Simulink Fig.17. For the system implementation, the whole system was implemented using Matlab, All the references were collected from the Matlab site. And CPU as HW. The fusion approach was implemented based on the Automated Driving Toolbox. AI is currently used and consists of the following modules: localization, detection, control, prediction, and planning.

Figure 17. Matlab-Simulink Development Environment System situation

4.2 Experiment Result of Yolov3

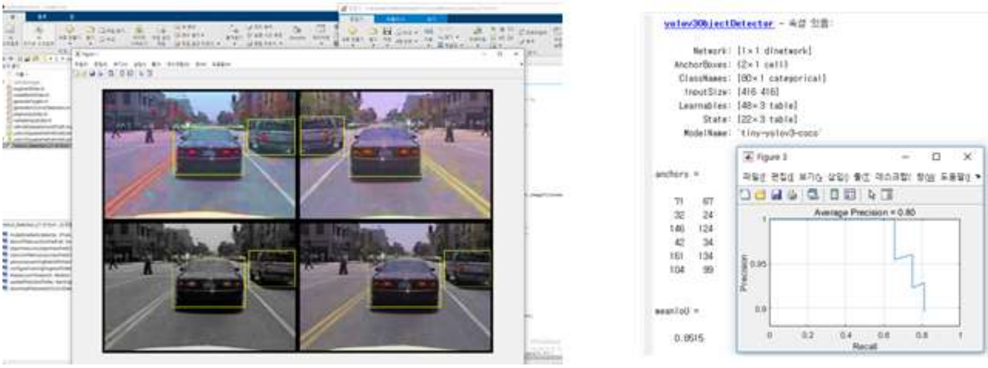


Figure18. Experiment Result of Yolov3

Our improved YOLO v3 detector Fig.35 and Fig.36 use the feature extraction network in SqueezeNet with the addition of two detection heads at the end which is twice the size of the first detection head. The result proves that it is more able to detect small objects

4.3 Overall System Experimental Results

a) Result in dangerous situation
b) Result in a safe situation

The green color of the vehicle detection result indicates that the distance to the vehicle in front is good and finally sends a signal to the controller to instruct it to maintain the same speed in the lane. In Fig. 19 (a), the vehicle's bounding box shown in yellow indicates a dangerous situation, but in b), the vehicle's bounding box is displayed in green to indicate that the vehicle is not in a hazardous situation. The vehicle distance problem is not very important in our algorithm, but we used it because it handles whether the distance to the vehicle in front is close or far based on the bounding box. In Figure 19 (a), when the distance to the vehicle in front is close, the

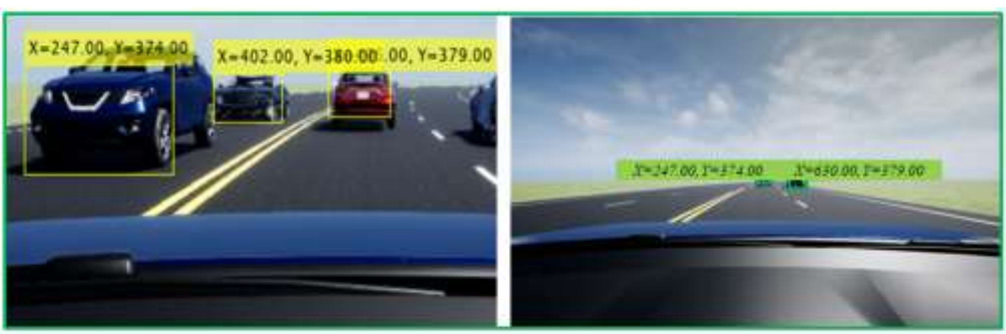


Figure 19 Overall System Result of Vehicle A and B

Fig. 19 (a) and (b) above is the final result of the proposed algorithm.

bounding box result is ɵ>0, and it is treated as

a dangerous situation. In our system simulation environment, we have marked the bounding box in yellow so that dangerous situations can be easily recognized. And when a dangerous

situation is detected so the autonomous vehicle sends a signal indicating a dangerous situation to drive and steer to control it as following the Break.
Fig. 19 (b) Can be confirmed by showing the result of a stable situation in which the distance from the vehicle in front is increased.

5. Evaluation

Table.3 Control Steer Execution

Estimation probability	Assortment	Driving after Action
$\phi > 0$	Safety situation	Keeping the Same Speed
$\phi < 0$	Unsafety situation	Break

And to quickly determine responses such as keep the same speed, stopping/Brake, deceleration Changing Lane so that better decisions can be made quickly Fig.46.

5.1 Performance of Vehicle Detection

The Running the Simulation in Vehicle A, Vehicle B, and Vehicle C. We run the simulation by executing the 'sldemo_absbrake' command, and vehicles A, B, and C Fig.20 A) are turned on during the simulation which has good accuracy and performance.
Our proposed system work 100% and show a better result after hiding or masking vehicle A called " A cars". We have limited vehicles A and Vehicle B, first, Yolov3 detection has been well detected on 98%, and vehicle detection performed well well with 96% of vehicle detection. The vehicle behavior without Vehicle A performed.

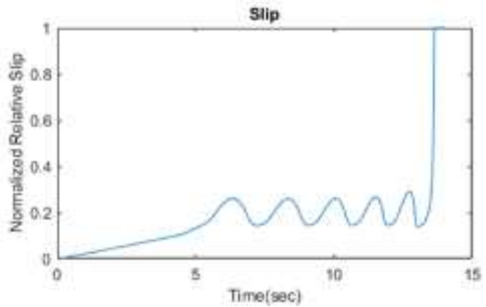


Fig 20. a) Performance with Vehicle A

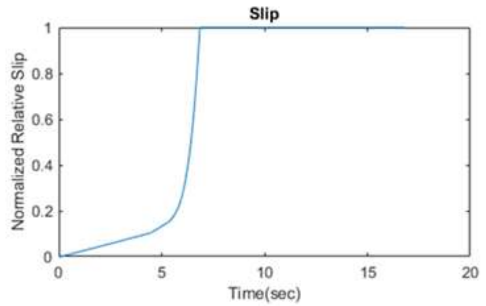


Fig 20. b) Performance without vehicle A

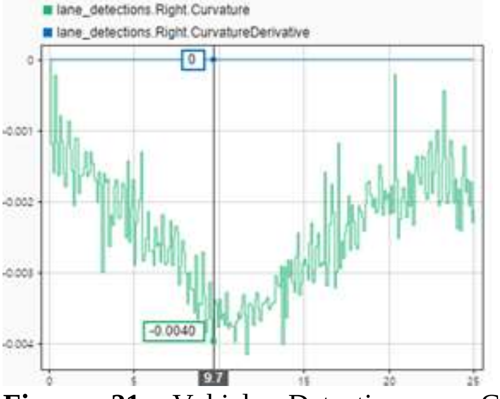


Figure 21. Vehicle Detection on Curve Situation

Table5. Comparison of autonomous driving car safety system of the previous studies and the proposed framework..

Comparison to other Studies						
Works	Criteria					
	Object Detection	Distance estimation	Vehicle Detection	Control Act Steer - Break	Real-Time Quickly Detection	Cost
P. Litman	×	✓	×	×	×	×
G. Parla	✓	×	×	✓	×	×
G. Liu	✓	×	✓	×	×	✓
Pan	×	×	×	×	×	×
Our Propose System	✓	✓	✓	✓	✓	✓

6. Related Work

6.1 Deep Learning and YOLOv3 Systems for Automatic Traffic Data Measurement by Moving Car Observer Technique (3)

In this subchapter, part shows the review of articles of journals, documents from the internet on what phishing is about and the methods or approaches used to detect and prevent phishing. These methods were reviewed based on their benefits and their weaknesses in solving phishing

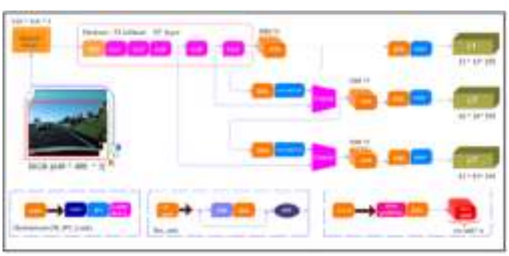


Figure 22 Existing System YOLOv3 Network

6.2 Optimized YOLOv3 Algorithm and Its Application in Traffic Flow Detections (4)

In Y. Q. Huang and J. Liu – Optimized YOLOv3 Algorithm and Its Application in Traffic Flow Detections When the data detections and statistical analyses of traffic flows have been further applied, traffic management departments can make better decisions on road infrastructure optimization or traffic limits to avoid a large number of traffic congestion and traffic accidents, and that can improve the life quality and convenience of urban people. This paper show some limitation about accuracy rates of traffic flow statistics and prediction information.

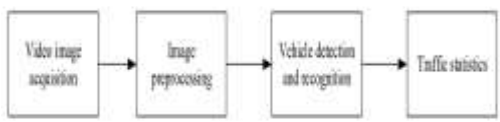


Figure 23. Existing Detection System Process

6.3 Optimized Design and Simulation of Autonomous Driving Algorithms (9)

This thesis study focuses on track center tracking algorithms. The vehicle models used for the design of the controllers are derived from the well-known bicycle model and have been widely used in the literature. The algorithm used here should drive, accelerate and brake autonomously to keep the vehicle on the track and minimize jerking (10), steering speed, and the difference between expected speed and actual speed. And the same point of our study is the following; Matlab and Simulink have been widely used. Subsequently, the artificial vision algorithms were studied in Figure 12. The various points and some limits of this study compared to our system are as follows; The use of convolutional neural networks for road maintenance in urban areas was discussed. An algorithm was coded to collect the training and validation data (images) and tag it, but no training or testing was done due to a lack of computing power.

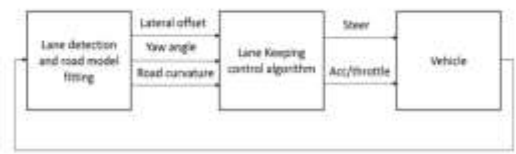


Figure 24. Existing System of Lane Keeping Algorithm building block

7. Conclusion

In this study, we proposed a method to detect vehicles in a curve road in real-time which is satisfying and accurate. Firstly, we have implemented the YOLOV3 algorithm for autonomous vehicle image recognition using the coco dataset from the Matlab site has a better performance compared to the previous method. Then, we have applied our "improve Yolov3" effectively by adaptive HighwayLaneFollowingTestBench/Simulation 3D Scenarioto prepare Matlab Simulink simulation environment and sensors to detect vision vehicle. We assign our proposed algorithm which is a computational method to detect the vehicle ahead using our YOLOv3 and compare the bounding box size of the detected object. The training parameters are refined through experiments. The vehicle detection rate is approximately 95.8%, while the detection applying YOLOv3 gave an accuracy of 98%. As per our best knowledge, as a result of the experiment, the proposed system has shown favorable results for the autonomous control vehicle detecting purposes to ensure the safety of autonomous vehicles by processing the collected data to recognize the situation.

Future Work: In future research, we plan to use the different sensors connected based deep learning will be used to simultaneously learn multiple agents to achieve better performance and deviation and improve learning efficiency. And we plan to detect le lane too.. The essence of carrying out this research is, therefore, in the right direction.

Acknowledgment

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