International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/IJSRCSEIT

Intelligent Self Driving Autonomous Car

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ARTICLEINFO

Article History:

Accepted: 10 April 2023
Published: 30 April 2023

Publication Issue
Volume 9, Issue 2
March-April-2023

Page Number
738-748

ABSTRACT

In the past century, autonomous vehicles have grown remarkably in the automotive sector in terms of dependability, price, and safety. We are living in the era of autonomous automobiles because to tremendous improvements in computer, networking, and other fields of technology. Many autonomous vehicle prototypes have been tested across numerous kilometers of test drives. Numerous well-known automakers have begun allocating significant funds to this technology in an effort to bring it to market in the near future. However, there are still a lot of technical and non-technical obstacles to overcome in order to accomplish this aim, including issues with real-time implementation, customer satisfaction, security and privacy concerns, policies, and legislation. By going over the advantages and disadvantages of autonomous driving technology, we want to shed light on future possibilities.

Keywords : Autonomous Cars, Path Planning, Driverless Cars, Safety, Privacy, Security

I. INTRODUCTION

In recent years, autonomous cars have been a prominent focus of automotive engineering research. Autonomous cars are becoming more pragmatic from year to year as multi-national companies are racing ahead to produce intelligent vehicles. The projected value for autonomous vehicles in the global market is at $615 Billion by 2026. According to the U.S. Department of Transportation's National Highway Traffic Safety [1] Administration (NHTSA) fully automated or autonomous vehicles are "those in which operation of the vehicle occurs without direct driver input to control the steering, acceleration, and braking and are designed so that the driver is not expected to constantly monitor the road- way while operating in self-driving mode.". The advancement and rise of autonomous cars are due to the significant research results obtained in the arenas of wireless and, embedded systems, sensors, communication technologies, navigation, data acquisition, and analysis [2]. The initial thought of autonomous cars was initiated in the year 1920 with the "phantom autos" concept, which means a remote-control device, which was used to control the vehicle [3]. Later in the 1980s self-managed autonomous cars were developed. Further, NavLab of Carnegie Mellon University contributed majorly in this field by developing an Autonomous Land Vehicle (ALV) [4]. In a major breakthrough in 1987, the "Prometheus project" of

Mercedes [5] gave the design of their first automated car with the capability of tracking lanes. At that time, it was not completely autonomous, but it had the ability to automatically switch lanes. In the twenty-first century, there is a huge demand for low-cost, high-performance autonomous cars. There is a fine line of difference between the two terminologies: the automated car and the autonomous car. The term automated car refers to a vehicle with little human intervention, whereas the term autonomous car refers to a vehicle without any human intervention. The autonomous car is a fully computer-controlled car which can instruct (guide) itself, make its own decisions, familiar with its surrounding without any human interference (intervention). The concept of connected car technology is influenced by autonomous cars [6] as both technologies are related to each other. Layered architectures are being proposed to address challenges faced due to the internet response time and the compatibility of various components that are being used in connected car technology [7]. Autonomous vehicles need to be connected to each other to improve overall autonomy when driving on the road. Throughout its journey, AI [8] and Big Data [9] have remained steady partners of the firm. Tesla has taken excellent use of AI and Big Data [10] for expanding its customer base. The firm has made use of existing customer databases for its data analytics using it to comprehend customer requirements and regularly updating their systems accordingly. In near future scenario where the autonomous cars are widespread, these networks will most likely also interface with cars from some other manufacturers as well as other systems such as road-based sensors, traffic camera, purge light up mask or smartphones [11].

II. Related Work

Till today, a number of works have been done to explore multiple issues of autonomous car system [12]. But the majority of surveys focus only on certain aspects of the autonomous car and none of these surveys present a comprehensive (holistic) method towards autonomous car technology. Campbell et al. [12] discussed the approaches to challenges faced in urban environments by autonomous vehicles. Okuda et al. [13] did a thorough survey on the usage of advanced driving assistance (ADAS) in autonomous cars and the trends in the technology. Fagnant et al. [14] helped in surveying the required policies to make a nation ready for autonomous vehicles. Moreover, Bagloee et al. [15] focused on a few challenges that such different policies provide to autonomous cars. Other surveys regarding its functionalities include planning and motion control [16], long-term maps' constructions [19] and visual perception from both implementation and operators' perspectives [18]. Furthermore, Abraham et al. [17] conducted a survey on consumer trust and also the preferences of the consumer on already available alternatives [20]. The research article "Working Models for Self-Driving [21] Cars with Convolutional Neural Networks, Raspberry Pi, and Arduino" by Aditya Kumar Jain. The proposed approach uses a pie camera mounted on a raspberry pie in the car to capture the image [22]. The Raspberry Pi is connected to the same network as the laptop, and the Raspberry Pi delivers the captured image to a convolutional neural network. The image is converted to grayscale before it is sent to the neural network. The model predicts one of four possible outcomes: left, right, forward, or stop. When the result is predicted, the Arduino signal will be activated and the car will be able to drive in a particular direction using the controller. The research paper "Self Driving Cars: A Peep into the Future" presented by T. Banerjee, S. Bose, A. Chakraborty, T. Samadder Bhaskar Kumar, T.K. Rana [23]. This research paper describes the design of embedded controller for self-driving, electric, impact-resistant, and directional GSM vehicles. The vehicle's position, starting point, and destination are properly tracked by the GPS module and the coordinates are mapped to allow navigation. When the vehicle is visible from the front, the speed of the vehicle is automatically adjusted by maintaining a safe distance, which is a function of speed. A stepper motor-driven rotational distance measuring sensor continuously monitors the distance between the vehicle in front and the vehicle on the side and adjusts the speed limit and lane change accordingly. The " Self-Driving and Driver Relaxing Vehicle " entitled paper published by a Qudsia Memon, Muzamil Ahmed, Shahzeb Ali, Azam Rafique Memon, and Wajiha Shah [24] In this study, they had created two self-driving car application that allows drivers to rest for a short period of time. It also presents a concept centered around the modified Google car idea, where Google cars need to arrive automatically at static destinations. In this prototype, they created a dynamic target. Here, self-driving cars track vehicles traveling along a given route. This vehicle is followed by this prototype. ChunChe Wang, ShihShinh Huang, LiChen Fu, Pei Yung Hsiao article "Driving Assistance System for Night Vision Lane Recognition and Vehicle Detection" [25]. The purpose is to improve driving by developing a support system. This study combines lane detection with vehicle identification technology to improve driver safety at night. It can detect lanes and help locate markers. To extract an edge, use a cenny edge [26] detection operation, followed by the selection of potentials edge points. The paper "A Vision-based Method for Improving Safety of Self Driving" by Dong, D., Li, X., [27] and Sun gives details about a simulator that can recognize traffic signs, lanes, and road segmentation. The use of blockchain technology [28][29] for training autonomous cars has been proposed by G. M. Gandhi et al. [30]. In this process, all connected cars can share their experience with each other. Blockchain can also be used to maintain energy transactions at charging stations [31]. Many recent surveys on autonomous cars have majorly focused on a few topics of autonomous cars.

III. Objectives

Design and integrate the necessary hardware components, including sensors and computing units, to create a functional self-driving car platform. Train and implement deep learning models to enable the car to perceive and interpret its environment accurately, including recognizing objects, detecting lanes, and understanding traffic signs. Develop decision-making algorithms that consider real-time sensor data, traffic rules, and safety requirements to make appropriate driving decisions. Implement a robust control system that translates decisions into precise actions such as acceleration, braking, and steering. Conduct thorough testing and validation to assess the performance, safety, and reliability of the self-driving car system in various real-world scenarios.

IV. Problem Identification

Self-driving cars are software based and almost all of human mistakes can be improved. Self- driving cars are an advance technological development in the field of automotive industry that is both a comfort and a safety feature for drivers. According to research by ASIRT (Association for Safe international road travel) on average 3,700 people lose their lives every day on the roads. An additional 20-50 million suffer non-fatal injuries, often resulting in long-term disabilities [32]. This mostly happens due to human mistakes. The number of People dying due to road accidents in some countries every year is shown in figure 1. The light green color represents accidents most likely due to Human Mistakes and towards red it is due to other factors. It can be clearly seen that Human mistakes have more percentage. To avoid such mistakes self-driving cars comes to the ground and are most demanding vehicles in the market.

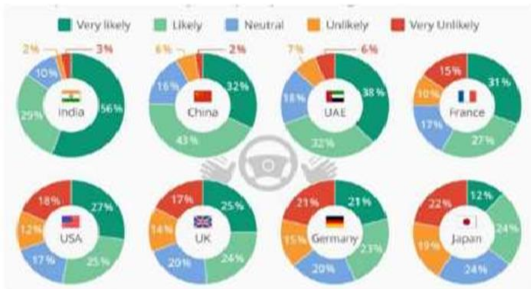

Figure 1: Graph for Death rates due to road Accident

V. Proposed Work

Self-driving cars works on image processing techniques on the basis of feature extraction. Every processing is done on each frame of the video. Machines does not take video as a stream of events it takes it as a stream of frames captured at each minimum instant of time. And all processing is done using those frames [33]. For a camera every image is a 2d mesh of colored pixels. It takes raw frame captured at each instant and converts it into threshold of black and white color then it detects the edges shown in figure 2. Edges are observed under Hough-lines method where collinear points are collected in to array of arrays and each array is then used as drawing points to draw straight lines. Orientations and length of line to be detected can be set in Hough-Lining. Then the angle of drawn lines is calculated and left or right decision is taken accordingly

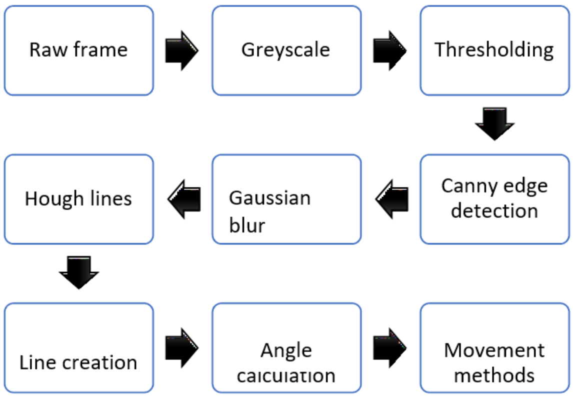

Figure 2: General Block Diagram for system architecture

5.1 Design Constraints

Our Autonomous Vehicle Prototype can detect lane to maneuver also detects hurdles with in the path. Our prototype also has smart control and smart lock using image processing. In this project we are to perform multiple task we are using single camera which make it cheaper and effective in market also some of sensors are neglected to reduce cost. We have used an Arduino UNO to control servo motors because raspberry pi's GPIO pins cannot provide enough [34] current to the servo motors as it operates on 5V but electronic components operate on 12V DC. We have used 5MP camera a cheaper version but there are some expensive ones with night vision andhigh resolutions also that are supportive to raspberry pi 4b.A problem I had faced during development is 'installation of open-cv python' in raspberry pi. I tried almost every effort according to my knowledge but it didn't install. Then I got a method having 20 steps to install that took me almost a full day and it worked. Second problem is that raspberry pi operates on 5v but all electronics components like motor driver and servo motors works on 12v to meet this problem I have used Arduino to power the parts using impulse generated by raspberry pi.

5.2 Design Methodology

Let's get started with the used libraries. The main libraries that are base of our project are CV2, Numpy and math-python. Cv2 is foundation of computer graphics and image processing and to manipulate arrays that we have used Numpy. Math is also a versatile library that saves you from writing long formulae by providing simple methods. I have used time library because it is used widely in microcontroller programming to put sleep time. We have three main modules that are lane detection, object detection and steering module through keyboard or through other network connected devices. In lane detection we are doingall preprocessing and detecting lanes to get lanes angles. Then comes the steering module in steering module we have used all the previous modules to get a continuous output. In steering module, we have made an iteration loop and at each iteration we are calling each module's methods to get the results and steer accordingly.

5.3 Development Methodology

First, we will discuss about lane detection. So to do so I have created a continuous for loop in the array of camera.capture_continuous() method. We have chosen rawcapture because we need clear image without any filter. Picture format as BGR just to get better results. And turned the raspberry pi camera port as true to get video from raspi-cam. If we were using ordinary web cam so we can have used a simple method cv2.read () followed by a while true loop to get the video. But raspberry pi needs some special treatments. So here's the line of code I have written for this:

for frame in camera.capture_continuous(rawcapture, format="bgr", use_video_port=True)

Then the frame is converted into an array because it is very quick method to manipulate the images

Image=frame.array

Next, we have converted the image into grey scale image to defuse the colors as we need edges at the end then to make the edges clearer, we have applied the technique of thresholding. Thresholding converts the image to a simple black and white threshold because cv2 can only see in 2 dimensions and it is necessary to remove the effects of third dimension that can be destructive to our plan. This is how thresholding looks like shown in figure 3 and 4.

Figure 3: Greyscale

Figure 4 : Greyscale to Threshold

5.4 Canny Edge Detection

Cv2 provides built-in method for canny edge detection so we does not need to write long lines of code. We just need to put in the image and provide threshold values. This way it will givedetected edges in the imagery shown in figure 5. To avoid excessive edgeswe slightly blurred the image by putting the threshold into GuassianBlure. These lines of code were used for canny edge Detection. ***blurred = cv2.GaussianBlur(gray, (5, 5), 0)***

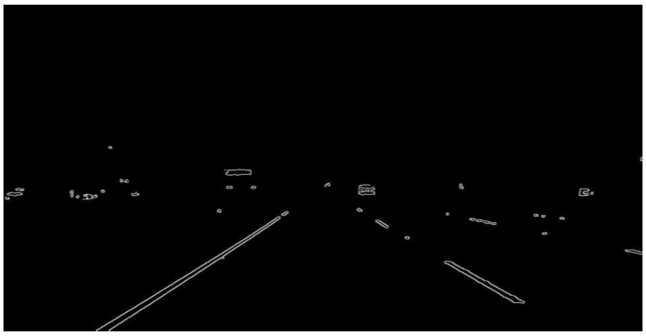

Figure 5: After Canny Edge Detection

Now we will get the lane lines. We will do this by drawing all the points that are adjacent to each other. So to get the adjacent pixels we will apply the HoughlinesP() method. We used this code for Hough lines detection.

lines = cv2.HoughLinesP(edged,1,np.pi/180,10,minLineLength,maxLineGap)

This will create an array of arrays or a 2d array of lines. To understand how these lines are working we need to draw those lines. For this there is not any built-in method so we did this manually.

```
if(lines !=None):
for x in range(0, len(lines)):
for x1,y1,x2,y2 in lines[x]:
cv2.line(image,(x1,y1),(x2,y2),(0,255,0),2)
```

First of all we need to check if there are lines in the array or not. Then we will iterate through whole array to get the variables for equation(i.e. x1, x2, y1, y2) of lines as we know the equation of line is **y=mx+b** where **m** is the slop of line and can be calculated as

$$Slope = \frac{rise}{run} \text{ Or } m = \frac{y_2 - y_1}{x_2 - x_1}$$

So we need to put parameters into cv2.line ( ) method and parameters are raw image, x1, x2, y1, y2, color of lines to be drawn, and thickness of the line.cv2.line() saves our effort to create slopand line equations. Then we have our unique technique to calculate angle of line curve, for this we will be using arctan() method to calculate inverse of tan-theta to get a solid value to compare with something.

theta=theta+math.atan2((y2-y1),(x2-x1))

After that the value of theta is compared to its boundary values that are used to tell when to go forward, backward, right or left.

To control the hardware like wheels we need to use GPIO pins of Raspberry pi. These pins works as switches for hardware components based on the zero and one commands we code.to control the motors we used a motor driver component L298N having 4 inputs for programming commands and 2 outputs for motors connection having separate positive and Negative terminalsfor each. A separate 12v or 3v input current socket. We have used the following pattern of GPIO commands.

For right direction:

GPIO1r = high GPIO2r = low
GPIO1l = low GPIO2l = High

For Left direction:

GPIO1r = low GPIO2r = high
GPIO1l = high GPIO2l = low

Where “R” is for Right motor and “L” is for left motor

5.5 High Level Design

It takes raw frame captured by car camera at each instant and is passes it through image preprocessing then angle for each line is calculated and on the basis of that angle it makes decision to steer the vehicle. It also take inputs from keyboard at same time. System has network control by which owner can control it using their mobile phone or PC. In future to carry forward our work we will add obstacle avoidance method that get raw input to avoid collision shown in figure 6.

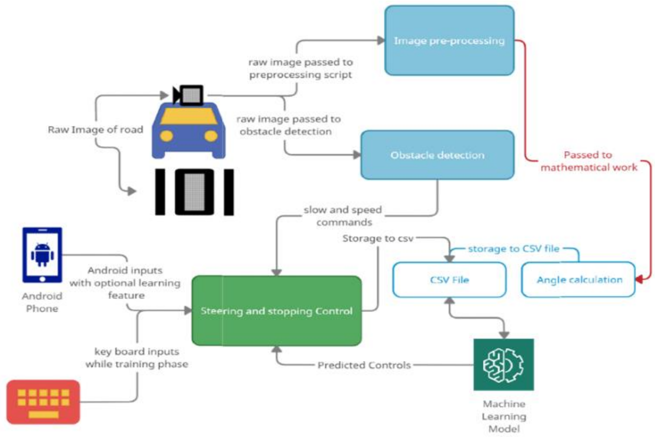

Figure 6: High Level Sign of the Lane Detection with Machine Learning

5.6 Low Level Design

The overall working of the system starts from the experimental subject (robot car in our case), the Robot car runs on the artificial lane that we have created for systems testing purposes, and the Camera attached on the car starts sending frames one by one to the preprocessing script in the lane Detection algorithm, the frames are converted into grey scale images so that the threshold script Algorithm can be used to classify the lane and the other areas based on the object shape and Intensity of the white and black colors, then the canny based edging algorithm identifies the edges Of each object in the threshold image and detects the lane by its shape, furthermore [35] the region of Interest (ROI) is used to extract features out of the canny based image and the final lane lines are Identified by the lane detection algorithm. Now in order for the lane detection system to work we must detect the obstacles that our robot car Might face, for this kind of scenario we pass down the raw images taken by the camera of the Robot car and pass it shown in figure 7.

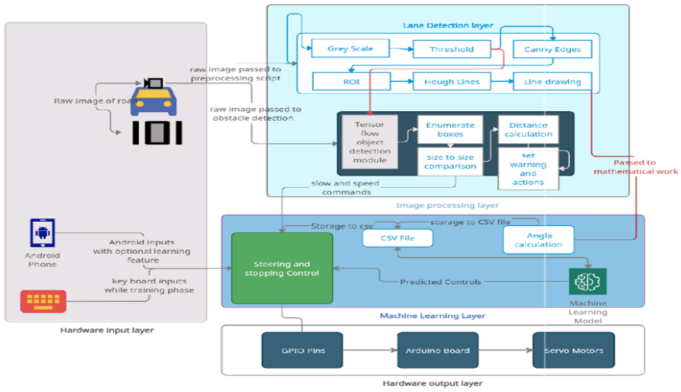

Figure 7: Low Level Design of the Lane Detection with Machine Learning

Down to the Tensorflow obstacle detection algorithm and we also provide it. The threshold images, these two data parameters are required for the obstacle detection algorithm To work, now there are few more functionalities that are required by this module, first is to predict Ground truth coordinates or bounding boxes for the object of interest and the size of the bounding box is calculated [36], if the size of the bounding is getting bigger or is big than that means obstacle is very close to us and if the bounding box of the object is smaller or getting smaller then that means that object is far from us, next the distance between that Object and robot car is calculated in the meantime to avoid the collusion so we create few warning and actions based on our relation with the potential obstacle or object.

VI. Outcome

Here we have tested results under different brightness levels and results are as follows. We have created three scenarios 1st tested in normal light as the figure 8, 9 and 10 shows here is has very clear recognition of lanes then in flashing light as shown in figure 11 to check if it is distracting or not. It did this in a clear manner with somehow less recognition but no distraction was noticed then in dark as shown in figure 12 it has tiny recognition but still no distraction at all.

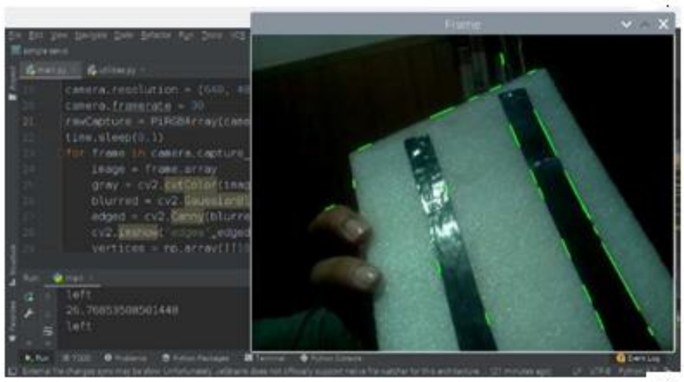

Figure 8: Flash Light

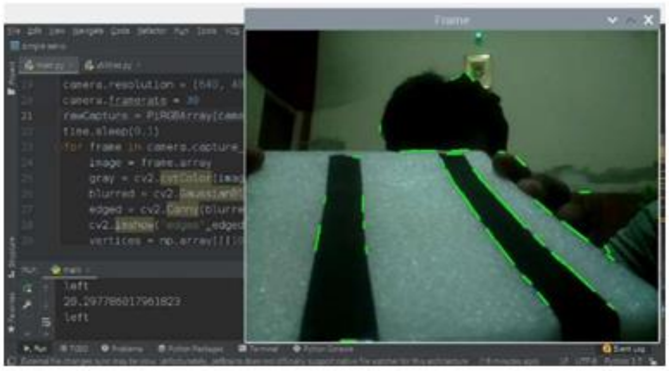

Figure 9: Normal Light

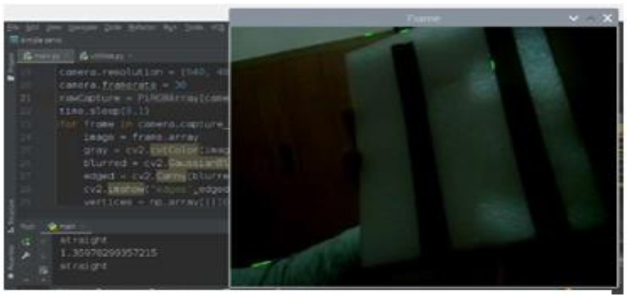

Figure 10: Dull Light

Here we have tested the whether out results are according to the direction of lanes and results are as follows. We have rotated this fake lane pad left and right and observed the results that are shown in figure 13.

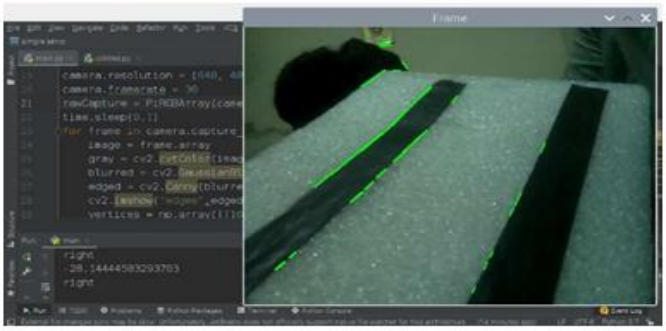

Figure 11: Right Rotated Lanes

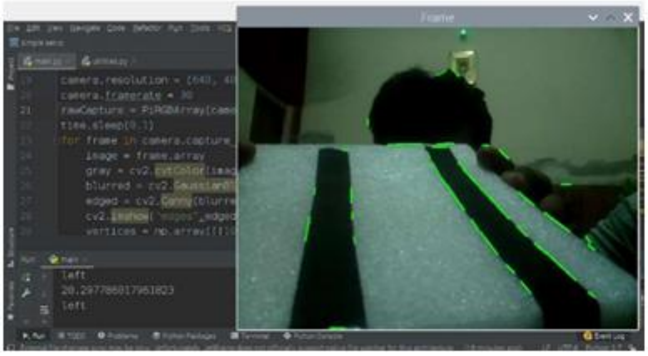

Figure 12: Left Rotated Lanes

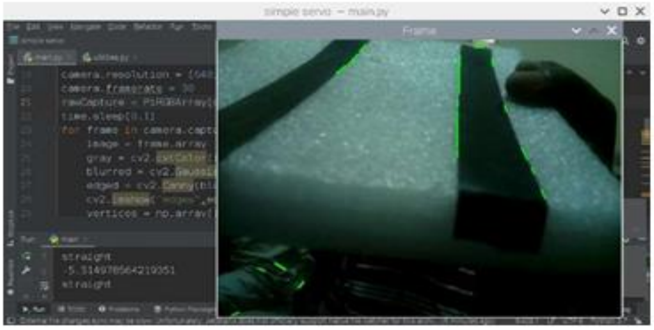

Figure 13: Straight Lanes

Our project captures raw image from raspberry pi camera and the program written in python environment starts doing preprocessing over it and converts the image to greyscale to make it colorless, this will help a lot in canny-edge-detection method. Then edges from canny methodare passed through Hough-lines method that gives the Numpy array of all collinear points. Then I have used these arrays to build lines. Each point from the array is given to cv2.lines method that converts all the points into lines and are shown in figure. But here a problem persists that this technique take the whole frame and calculates edges and line from the whole frame.to overcome this problem I have used bitwise operations shown in figure 14 and 15. First I have calculated the resolution of screen and cropped out its parts that were out of the lanes using bitwise OR operation of Open-cv python. In this way edges outside the lanes will not distract our car. Everything seems good but there's another problem that parallel line always looks tilted towards the center when seen from the distance. Same is the issue for road lanes. They looks parallel but at the same time they are pretended to be meeting at the center to fulfil this gap we need to take bird's eye image of the road. For this purpose we are using a technique called warping or warp perspective transform. After warping we can get bird's eye view of the road and exact angle of lanes. While moving on the road raw image is being used by another feature that is object detection. Whenever the camera detects an object it calculate its size comparatively to the screen and according to the size we can have a rough idea about the distance of our car to the next objector other vehicle.

Figure 14: Car Chassis of Proposed Model

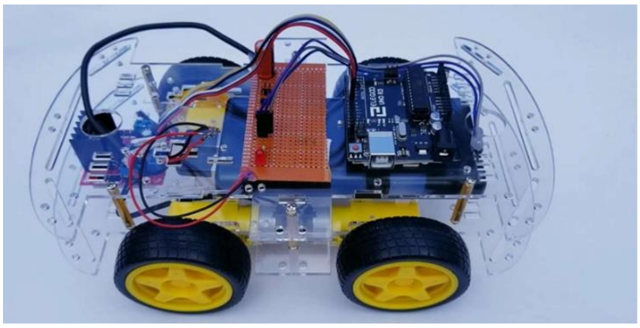

Figure 15: Car Chassis of Proposed Model

VII. Conclusion

Many automaker firms are currently producing autonomous cars since the automotive business is rapidly evolving. The auto industry faces several issues, such passenger and vehicle safety, as well as a variety of new commercial prospects. An autonomous driving system that overcomes the drawbacks and difficulties of conventional human-operated cars is the goal of the self-driving car project. The goal of the project is to develop a self-driving automobile system that is dependable, safe, and efficient by using cutting-edge sensors, algorithms, and real-time data analysis. Increasing accessibility for those who are unable to drive is one of the project's goals, along with lowering the number of incidents on the road that result from human mistake and increasing traffic efficiency by maximising flow and decreasing congestion. The initiative further seeks to support environmental. In addition, by creating eco-friendly driving habits and cutting emissions, the initiative hopes to support environmental sustainability. Perception and sensing, planning and decision-making, real-time responsiveness, safety procedures, mapping and localization, and resolving ethical and regulatory issues are some of the project's main areas of attention. The goal of the self-driving car system is to overcome these obstacles and offer passengers a smooth and enjoyable driving experience while abiding by the law and moral principles. The project's results have the potential to completely change the transport sector by reshaping metropolitan areas, lowering the number of traffic deaths and accidents, maximising the use of available space, and enhancing societal mobility and accessibility. The initiative recognises that careful consideration of technology breakthroughs, legislative frameworks, and public acceptability is necessary for the development and implementation of self-driving automobiles. The project is to enhance autonomous vehicle technology and open the door to a future in which these cars would significantly influence transportation systems for the benefit of society via thorough study, development, and testing.

VIII. Future Enhancements

In future self-driving car projects, there will be a focus on implementing object detection capabilities to identify objects on the lane. Additionally, a learning feature will be incorporated to enable the system to prioritize and detect specific obstacles to avoid collisions. This development aims to enhance the perception abilities of the autonomous system, enabling it to make informed decisions and take appropriate actions based on the presence of vehicles, pedestrians, cyclists, and other potential road hazards. The goal is to improve safety and ensure efficient navigation in diverse driving scenarios.

IX. REFERENCES

[1]. Mumdouh Mirghani Mohamed Hassan,Y. Perwej, Awad Haj Ali Ahmed, Firoj Parwej,“ Using Intelligent Transportation Systems the Modern Traffic Safety on the Highway in the Sudan” , International Journal of Computer Science Trends and Technology (IJCST), ISSN 2347 – 8578, Volume 7, Issue 3, Pages 1- 13, 2019, DOI: 10.33144/23478578/IJCST-V7I3P1

[2]. Guerrero-ibanez JA, Zeadally S, Contreras-Castillo J. Integration challenges of intelligent transportation systems with connected vehicle, cloud computing, and internet of things technologies. IEEE Wirel Commun.22:122–8, 2015

[3]. Lafrance A. Our grandmother’s driverless car. https:// doi. org/ https:// www. theat lantic. com/ techn ology/ archi ve/2016/ 06/ beep- beep/ 489029/; 2016.

[4]. Kanade T, Thorpe C, Whittaker W. Autonomous land vehicle project at cmu. In: Proceedings of the 1986 ACM Fourteenth Annual Conference on Computer Science, CSC ’86, (New York, NY, USA), pp. 71–80, ACM, 1986.

[5]. Schmidhuber J. Robot car history. https:// doi. org/ http:// people. idsia. ch/ ~juerg en/ robotcars. html.

[6]. Guerrero-ibanez JA, Zeadally S, Contreras-Castillo J. Integration challenges of intelligent transportation systems with connected vehicle, cloud computing, and internet of things technologies. IEEE Wirel Commun, 22:122–8, 2015

[7]. Contreras-Castillo J, Zeadally S, IbÃaÃsez JAG. A seven layered model architecture for internet of vehicles. J Inf Telecommun., 1(1):4–22, 2017

[8]. Y. Perwej, "The Bidirectional Long-Short-Term Memory Neural Network based Word Retrieval for Arabic Documents", Transactions on Machine Learning and Artificial Intelligence (TMLAI), Society for Science and Education, United Kingdom (UK), ISSN 2054-7390, Volume 3, Issue 1, Pages 16 - 27, Feb 2015, DOI: 10.14738/tmlai.31.863

[9]. Y. Perwej, "An Experiential Study of the Big Data", International Transaction of Electrical and Computer Engineers System (ITECES), USA, ISSN (Print): 2373-1273 ISSN (Online): 2373-1281, which is published by Science and Education Publishing, Volume 4, No. 1, Pages 14-25, March 2017, DOI: 10.12691/iteces-4-1-3

[10]. Firoj Parwej, Nikhat Akhtar, Y. Perwej, "A Close-Up View About Spark in Big Data Jurisdiction", International Journal of Engineering Research and Application (IJERA), ISSN: 2248-9622, Volume 8, Issue 1, (Part -I1), Pages 26-41, 2018, DOI: 10.9790/9622-0801022641

[11]. Y. Perwej, Dr. Shaikh Abdul Hannan, Firoj Parwej, Nikhat Akhtar, "A Posteriori Perusal of Mobile Computing", International Journal of Computer Applications Technology and Research (IJCATR), ATS (Association of Technology and Science), India, ISSN 2319–8656 (Online), Volume 3, Issue 9, Pages 569 - 578, 2014, DOI: 10.7753/IJCATR0309.1008

[12]. Campbell M, Egerstedt M, How JP, Murray RM. Autonomous driving in urban environments: approaches, lessons and challenges. Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences. 2010;368(1928):4649–72.

[13]. Okuda R, Kajiwara Y, Terashima K. A survey of technical trend of adas and autonomous driving. In: Proceedings of Technical Program - 2014 International Symposium on VLSI Technology, Systems and Application (VLSI-TSA), pp.1–4, 2014.

[14]. Fagnant DJ, Kockelman K. Preparing a nation for autonomous vehicles: opportunities, barriers and policy recom- mendations. Transportation Research Part A: Policy and Practice. 2015;77:167–81.

[15]. Bagloee SA, Tavana M, Asadi M, Oliver T. Autonomous vehicles: challenges, opportunities, and future implications for transportation policies. Journal of Modern Transportation. 2016;24:284–303.

[16]. Paden B, Änãap M, Yong SZ, Yershov D, Frazzoli E. A survey of motion planning and control techniques for self- driving urban vehicles. IEEE Trans Intell Vehicles. 2016;1:33–55.

[17]. Abraham H, Lee C, Brady S, Fitzgerald C, Mehler B, Reimer B, Coughlin JF. White paper: Autonomous vehicles, trust, and driving alternatives: A survey of consumer preferences. Tech. Rep. 2016–6, MIT AgeLab, Massachusetts Institute of Technology, Cambridge, MA; 2016.

[18]. Shi W, Alawieh MB, Li X, Yu H. Algorithm and hardware implementation for visual perception system in autonomous vehicle: A survey. Integr VLSI J. 2017;59:148–56.

[19]. G, Alsayed Z, Yu L, Glaser S. Simultaneous localization and mapping: A survey of current trends in autonomous driving. IEEE Transactions on Intelligent Vehicles. 2017;2:194–220.

[20]. Ankit Kumar, Neha kulshrestha, Y. Perwej, Ashish Kumar Srivastava, Chandan Mani Tripathi, "The Assay of Potholes and Road Damage Detection", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 8, Issue 1, Pages 202-211, January-February-2022, DOI: 10.32628/CSEIT228135

[21]. A. K. Jain, "Working model of Self-driving car using Convolutional Neural Network, Raspberry Pi and Arduino," 2018 SecondInternational Conference on Electronics, Communication and Aerospace Technology (ICECA), 2018, pp. 1630-1635, doi:10.1109/ICECA.2018.8474620.

[22]. Shubham Mishra, Mrs Versha Verma, Nikhat Akhtar, Shivam Chaturvedi, Y. Perwej, "An Intelligent Motion Detection Using OpenCV" , International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Print ISSN: 2395-1990 , Online ISSN : 2394-4099, Volume 9, Issue 2, Pages 51-63, March-April -2022, DOI: 10.32628/IJSRSET22925

[23]. Raivo Sell, Anton Rassõlkin, Mairo Leier, Juhan-Peep Ernits, "Self-driving car ISEAUTO for research

and education"in 19th international conference onResearch and Education in Mechatronics (REM), IEEE, 2018, pp: 111-116.

[24]. T. Banerjee, S. Bose, A. Chakraborty, T. Samadder, Bhaskar Kumar, T.K. Rana, "Self Driving Cars: A Peep into the Future", IEEE, 2017, pp: 33-38.

[25]. Qudsia Memon, Muzamil Ahmed and ShahzebAli, "SelfDriving and Driver Relaxing Vehicle", in IEEE 2016, pp: 170-174.

[26]. Neha Kulshrestha, Nikhat Akhtar, Dr. Yusuf Perwej, "Deep Learning Models for Object Recognition and Quality Surveillance", International Conference on Emerging Trends in IoT and Computing Technologies (ICEICT-2022), ISBN 978-10324-852-49, SCOPUS, Routledge, Taylor & Francis, CRC Press, Chapter 75, pages 508-518, Goel Institute of Technology & Management, Lucknow, May 2022, DOI: 10.1201/9781003350057-75

[27]. Mohammad Faisal Bin Ahmed, Md. Saef Ullah Miah, Md. Muneef Anjum Timu, Shakura Akter, Md. Sarker.b, "The Issues and the Possible Solutions for Implementing SelfDriving Cars in Bangladesh" in Regin 10 Humanitarian Technology Conference(R10-HTC), IEEE,2017, pp: 250- 254.

[28]. Y. Perwej, Nikhat Akhtar, Firoj Parwej, "A Technological Perspective of Blockchain Security", International Journal of Recent Scientific Research (IJRSR), ISSN: 0976-3031, Volume 9, Issue 11, (A), Pages 29472 – 29493, November 2018, DOI: 10.24327/ijrsr.2018.0911.2869

[29]. Asif Perwej, Dr. Kashiful Haq, Dr. Yusuf Perwej, "Blockchain and its Influence on Market", International Journal of Computer Science Trends and Technology (IJCST), ISSN 2347 – 8578, Volume 7, Issue 5, Pages 82- 91, Sep – Oct 2019, DOI: 10.33144/23478578/IJCST-V7I5P10

[30]. Gandhi GM, Salvi. Artificial Intelligence Integrated Blockchain For Training Autonomous Cars. In: 2019 Fifth Interna-tional Conference on Science Technology Engineering and Mathematics (ICONSTEM), 2019, pp. 157–161, https://doi. org/ 10. 1109/ ICONS TEM. 2019. 89187 95.

[31]. Aguilar Cisneros JR, Fernández-y-Fernández CA, Juárez Vázquez J. Blockchain Software System Proposal Applied to Electric Self-driving Cars Charging Stations: A TSP Academic Project. In: 2020 8th International Conference in Software Engineering Research and Innovation (CONISOFT), 2020, pp. 174–179, https:// doi. org/ 10. 1109/ CONIS OFT50 191. 2020. 00033

[32]. 32] Joy J, Gerla M. Internet of vehicles and autonomous connected car - privacy and security issues. In: 2017 26th International Conference on Computer Communication and Networks (ICCCN), pp. 1–9, 2017.

[33]. Parkinson S, Ward P, Wilson K, Miller J. Cyber threats facing autonomous and connected vehicles: Future challenges. IEEE Trans Intell Transport Syst. 2017;99:1–18.

[34]. Hulse LM, Xie H, Galea ER. Perceptions of autonomous vehicles: Relationships with road users, risk, gender and age. Saf Sci. 2018;102:1–13.

[35]. Bresson G, Alsayed Z, Yu L, Glaser S. Simultaneous localization and mapping: A survey of current trends in autonomous driving. IEEE Transactions on Intelligent Vehicles. 2017;2:194–220

[36]. Fu M, Song W, Yi Y, Wang M. Path planning and decision making for autonomous vehicle in urban environment. In: 2015 IEEE 18th International Conference on Intelligent Transportation Systems, pp. 686–692, 2015

Cite this article as :

Nishant Mishra, Tushar Kr. Pandey, Vishal Pandey, Aman Mishra, Vivek Rai, "Intelligent Self Driving Autonomous Car", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 9, Issue 2, pp.738-748, March-April-2023.