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Lane Detection For Autonomous Cars Using Machine Learning

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Abstract— Lane detection is one of the main feature in autonomous cars to assist the driver. Lanes are detected by using the white color markings on the road along which the car travels. Lane detection uses the previously detected lane markers and moves accordingly. Most commonly used methodologies to implement the lane detection systems are Hough Transform, Edge detection, etc.

Background: An autonomous car should be able to go anywhere a traditional car can go and it should be capable of doing everything an experienced human driver does. Autonomous cars make use of lane detection which allows it to go in a specified lane, but lane detection also has its own drawbacks. From time-to-time technology of autonomous cars has been improved which allows it to imitate a human driver.

Methods: Autonomous cars should be able to imitate a human driver and should be able to go anywhere. Therefore, it should be trained properly to work without making any errors. The main concept used in autonomous cars is edge detection. The system processes the images (video frame) where it undergoes many steps and finally edges i.e. road lane are detected.

Results: Through Lane Detection System we can achieve the following features - Emergency Braking, High Beam Detection, Traffic Light Detection, Lane Keep Assist and Lane Departure Warning System.

Conclusion: As we all know road accidents affects people's safety, so lane detection plays an important role in avoiding accidents. Lane detection is very challenging for CV and ML approaches. In recent years many ML and CV algorithms have been frequently rolled out but they have been unable to produce sufficient results. This paper presents a decent approach to avoid road accidents and assures driver safety.

I. BACKGROUND

Autonomous cars get along with high end technologies to achieve driver safety. Another reason behind this is to provide improved safety conditions by fully or partially automating the driver tasks.

The main reason for adding autonomous features in vehicles is to ensure safety. Vehicle accidents are the leading cause of deaths and injuries. Many of these are happening on national highways. Hence, a method which can alert the driver can potentially save a number of lives.

Technologies in autonomous cars has improved significantly over time. Earlier during crashes, the best a person could hope for was an airbag. Now we have safety features including crash avoidance technology. Lane departure warnings is one of the safety measures. Throughout the years that followed the lane departure warning feature became the most common element in many autonomous cars.

The major breakthrough in lane departure technology was in 2004. The system was added to a model that would monitor the road conditions and assist the driver. This was done by sending signals to the system to gently encourage the driver to make a correction. We were quite far away from a decent autonomous car technology, but some drivers resisted these technologies.

We may still be a little away from a car that drives us to the office automatically, but we have achieved some progress. The latest development was done by feeding information from a dozen ultrasonic sensors to the car.

II. EXISTING SYSTEM

Since early 1990's, they need been studied and implemented for the situations defined by the great viewing conditions and

thus the clear lane markings on road. Later, the accuracy of particular situations, the robustness for an honest range of scenarios, time efficiency and integration into higher-order tasks define visual lane line detection and tracking as a unbroken research subject. at this , these kinds of lane marking line detection methods supported machine vision and image processing are often divided into two categories: the traditional image processing and semantic segmentation (includes deep learning) methods. the previously mentioned mainly involves feature-based and model-based steps, and which can be classified into similarity- and discontinuity-based ones; and thus the model-based step includes different parametric line , curve or pattern models. The later consists of varied machine learning, deep learning methods, and neural network which is that the new trend for the research and application of lane line departure warning systems.

III. METHODS FOR LANE DETECTION

Autonomous cars should be able to imitate a human driver and should be able to go anywhere. Therefore, it should be trained properly to work without making any errors. The main concept used in autonomous cars is edge detection. The system processes the images (video frames) where it undergoes many steps and finally edges are detected.

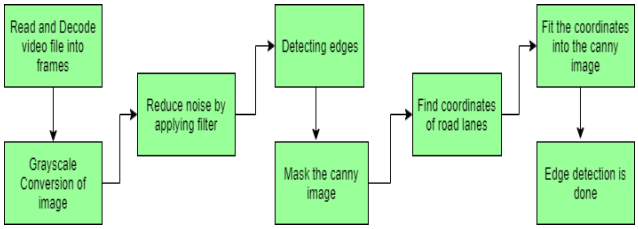

Figure 1. Methods for lane detection

a. **Capturing and decoding video file:** So, Firstly to detect the road, The video should be captured and this is done by the front camera that is mounted on the front of the car and after the video has been recorded by the camera, Video is first converted into images I .e frames and then it is decoded.

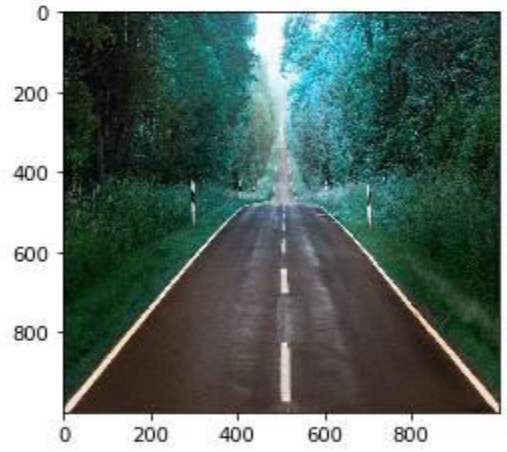

Fig 2. Raw File

b. **Grayscale conversion of image:** The captured image or video is usually in RGB format. Then it is converted into grayscale format. To process a RGB format image is difficult, hence it is converted to grayscale and then processed.

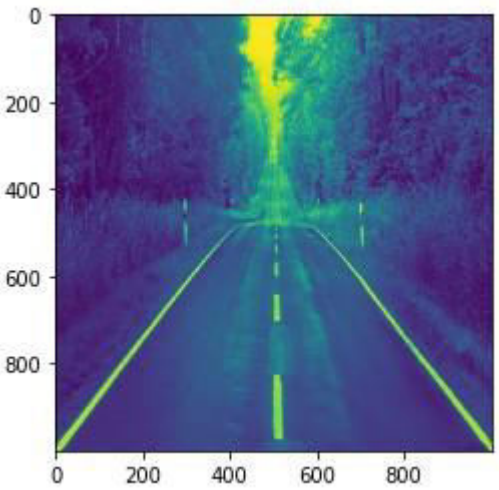

Fig 3. Gray Scale Conversion of image

c. **Reduce noise:** Noise has ability to create false edges, therefore before going to further steps, it's imperative to perform image smoothening and removing unnecessary elements. Gaussian filter is specifically used to perform this process. Edges cannot be detected properly if there is noise in an image or video. Therefore, utmost importance is given for image smoothening. This process is done by Gaussian filter.

d. **Canny Edge Detector:** It makes use of the blurred image from Gaussian filter and performs gradient on this image and by manipulating the intensity it tracks the edges. This method is based on the idea of identifying points in an image at which image brightness changes sharply. Edge is a organized set of curved line segments. This set contains points at which brightness of image changes sharply. Edge Detection may be a tool utilized in image processing for feature detection and extraction. This algorithm significantly reduces data to be processed and should therefore remove less relevant information while preserving important properties of a picture. If this algorithm is successful, the task of interpreting the knowledge in original image could also be simplified. However it's not always possible that ideal edges are often obtained from real world images of recent complexity. An edge detection algorithm called canny edge detector is employed to detect edges in a Picture. This method uses many stage algorithm and aims in discovering the optimal edge detection. Canny edge detector is an edge detection algorithm that uses many stage algorithm so as to detect edges in images. Its aim is to get the optimal edge detection.

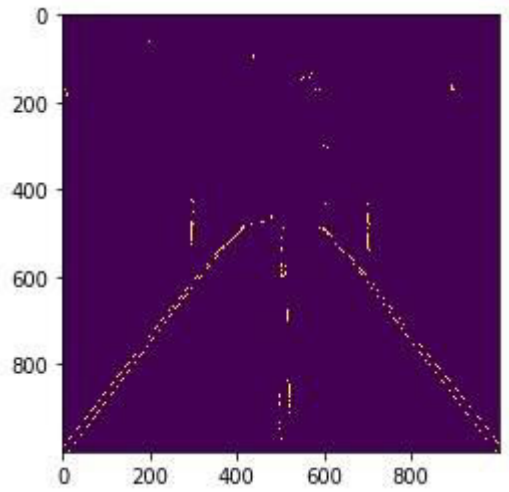

Fig 4. Canny Edge Detector

e. **Region of Interest:** Here only the region masked by the road lane is considered for lane detection. A mask will be of the same dimension as our image or video. It masks the image or video and shows the region of interest.

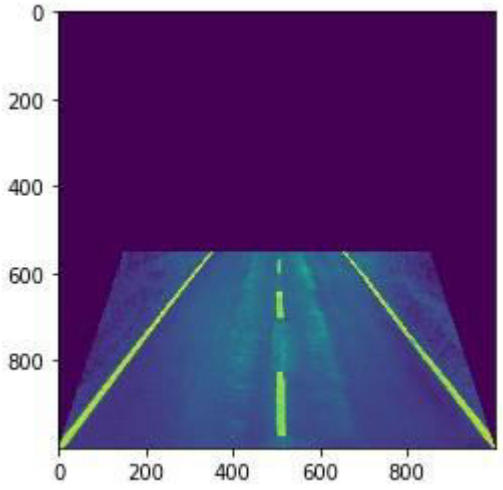

Fig 5. Detecting Region of Interest

f. **Hough Line Transform:** Straight lines are detected using Hough Line Transform. Hough Transform is a technique used for extracting features that can be used in image analysis and digital image processing. Traditional Hough Transform is essentially used for identifying lines within the images. There was an issue in detecting straight lines, circles etc. in automated analysis of digital images. The edge detector has been utilized in pre-processing stage for obtaining points on image that lie on desired curve but thanks to some problem in image, a number of the pixels were missing on desired curve. So for solving this problem Hough Transform is used. Hough Transform is an efficient [8] tool for the detection of straight lines in images, even within the presence of noise and occlusion. By counting unique equation for each possible line through point of image, it's ready to find dominant lines in a picture . By selecting pixels form image object set, the sting pixels are often grouped into an object

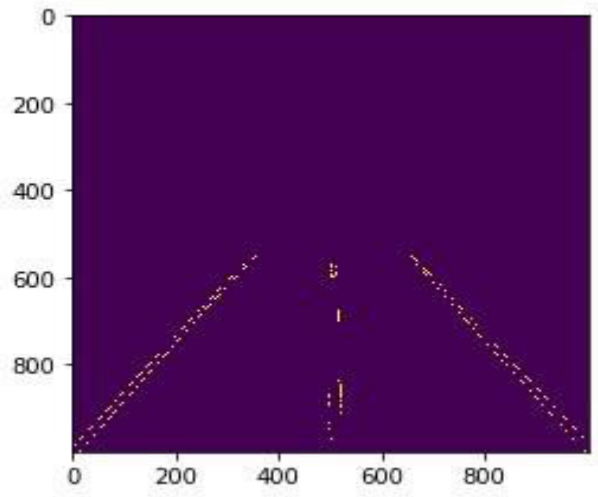

Fig 6. Hough line Transform

IV. RESULTS

In this project, the algorithm is implemented using Dell Inspiron 15 5000 Series with Intel i5 core computer using OpenCV package in Spyder 4. We will be using database that contains images or videos that have been taken for the experiment.

Fig 7. Boundary of a road lane

From Figure 2 we can see the lane boundary detected using the algorithm. Moreover, we can observe accuracy and performance of the algorithm. Although we see the performance there might be some problems that might still require some corrections.

In the end along with the algorithm we will get the output for the features mentioned below.

Emergency Braking: This system is proactive, which provides emergency braking assistance. The system warns the person driving, nevertheless if the person driving does not respond by that time the system takes required measures automatically. The Emergency Braking System uses radars, sensors, cameras and lasers to watch the roads and detects a possible risk of a collision with any pedestrian, vehicle or any other hazard. This system provides a visible or audible warning to the driving force or intervenes if needed.

AEB is an intelligent system that can:

•Alert the driver of an imminent crash.

•Assist to use car brakes to their maximum capacity.

•Automatically apply brakes for the driving force in critical conditions

High Beam Detection: These are frontal lights of the vehicle that can be dimmed or dipped automatically, depending on the other vehicle coming in the opposite direction. The driver instead of manually handling these operations the system can do this on its own. The driver can choose to put this operation on manual mode. The high beam is changed to low beam when the headlights or tail lights of other cars are captured on the camera. The beam is set back to high when these lights are in far proximity.

Traffic light Detection: This system is used for detecting traffic light signal at any weather condition. This feature is included so that the autonomous cars can follow rules and regulations by default.

Lane Keep Assist with Departure Warning: Some lane departure warning systems are activated by when u press a button, while others are automatically activated when you turn on your car. Their would be a Button which has indicator light shows when the system is active. The lane departure warning system searches for lane markings when the car is on a straight or slightly curved road and your turn signals are off. The lane departure system uses cameras located underneath the side view mirrors to recognize lane markers. To function properly, the paint stripes needs to be visible clearly on both sides of the vehicle. If the system detects that your car is too close to the left or right side lane markings, a warning light, a vibration, and/or sound will be activated. The feature uses a front of the inside rear view mirror forward-looking camera that's mounted behind your vehicle's windshield.

- A green LANE KEEP ASSIST icon is displayed When a left or right lane line is detected, the icon looks like either a vehicle with white lines on either side or two-lane lines, depending on your vehicle.
- If the system detects that your vehicle is about to leave its lane unintentionally, a LANE KEEP ASSIST icon is displayed.

Fig 8. Instrument Cluster LKAS Indication

If the vehicle's distance to the lane markings falls below an outlined minimum, the system steps in. In vehicles with electrical power steering, it gently, but noticeably counter steers in order to keep the vehicle in the lane. In vehicles without electric power steering, it achieves an equivalent effect by utilizing the Electronic Stability Program to brake individual wheels.

• Drivers can override the function in the least times, in order that they retain control of the vehicle. If they activate the blinker so as to intentionally change lanes or turn, the system does not intervene.

V. CONCLUSIONS

Around 3,700 people die in traffic every day around the world, and 100,000 are injured. The automotive industry is striving to make driving safer. In this project, a lane detection algorithm based on images or video taken from a vehicle driving is being proposed. We use different frames to show lane detection and its features. The lanes are detected using Canny edge algorithm and Hough transformation. The proposed project can be applied to painted roads. Since lanes are normally long smooth curves, we consider them as straight lines within a range. There are many problems because of the shadows created on the roads which maybe considered as obstacles by the algorithm. All these have to be solved by enhancing the algorithm and its performance.

we propose a local-based bottom-up solution for lane detection. Experimental results show the key point estimation and thus the coarse-to-fine refinement strategy circumvent the influence from ambiguous and noisy pixels, effectively improves the accuracy of curve geometry. More importantly, the principle of that specialize in local geometry and the bottom-up pipeline are proved to be particularly resultful, which significantly simplifies the task by reducing the dimension of the output of CNN and is believed to be the principal explanation for the superb performance and generalization capacity.

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