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Lane Line Detection System In Python Using OpenCV

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Abstract: *Lane line detection is a critical component of autonomous driving systems and advanced driver assistance systems (ADAS). The Lane line detection system is implemented in Python and uses computer vision OpenCV. The technology was developed to recognize and detect road lane lines in order to guide and assist drivers. It developed a processing pipeline that works on a series of individual images and applied the result to a video stream.*

Keywords*:* OpenCV (open source computer vision), lane detection, Hough transform, Canny edge detection

I. INTRODUCTION

Traffic accidents have become one of the most important issues in today's globe. Roads are the most popular means of transportation The most common traffic concern is driver irresponsibility, which has gotten increasingly significant as the number of cars on the road has increased. Road lanes or white markings that aid drivers in identifying the road area and nonroad area can help to decrease these road accidents. This technology enables multiple users to be better informed and to use transport networks in a safer, more coordinated, and smarter manner. Road lanes or white signs that aid the motorist in identifying the road area and non-road regions can help to reduce these road accidents. marked lane is a section of the road that can be used by a single line of vehicles to guide and manage traffic so that collisions between vehicles are minimized. A minimum of two lanes, one for traffic in each direction, are present on most roads, including highways. These lanes are distinguished by lane markings. There are frequently two lanes-per-lane, median-separated roads on major thoroughfares. It's necessary to use technology that can guide drivers in safe driving in order to recognize these road lanes. For self-driving cars and computer vision systems in general, lane line identification is an important stage. To reduce the risk of entering another lane and to specify the route for self-driving motor vehicles, this concept is used. It will locate the lane markings that autonomous vehicles have to obey over the road using Python computer vision techniques. This will be a crucial component of autonomous vehicles because they shouldn't cross their lane or go into the other lane to prevent accidents.

II. PROPOSED SYSTEM

The system takes input from a camera mounted on the vehicle's dashboard, capturing a stream of video frames. Alternatively, it can also accept pre-recorded video files The input frames undergo pre-processing steps to enhance the lane line detection process. This includes converting the frames to grayscale, applying Gaussian blur to reduce noise, and adjusting the contrast or brightness if necessary. For lane change support surrounding the test car, it presented a strategy to recognize lanes, detect, and track multiple vehicles. Vehicle candidates are found in each lane based on the horizontal edge characteristic of the cars paired with the identified lane regions, and the vertical edge is used to confirm the vehicle candidates. employ the Kalman filter to forecast and monitor the vehicle target in erroneous detection instances. This system can be implemented to help autonomous driving systems understand lane markings better and improve the overall safety and lane discipline of this autonomous vehicle.Lane Line detection is a critical component for self-driving cars and also for computer vision in general. This concept is used to describe the path for self-driving cars and to avoid the risk of getting in another lane.

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III. METHODOLOGY

Despite the obvious simplicity of finding white lines on a simple road, determining lane markers on various types of roads may be very difficult. These issues can include shadows, delays by other cars, changes in the road surface itself, and various forms of lane markers. A lane detection system must be that can perform detection and filter all types of road markings in order to generate a credible estimate of the vehicle's position relative to the lane. To recognize road markers and road limits, several approaches such as the Hough Transform, Canny edge detection algorithm, and Kalman filter are used

IV. SYSTEM ARCHITECTURE

This project,Using Python and OpenCV, will identify lane lines in images. The term "OpenSource Computer Vision" refers to a collection of tools for image analysis called OpenCV. It can choose colors, and regions of interest, and use grayscale, Gaussian smoothing, Canny Edge Detection, and Hough Transform line detection techniques.

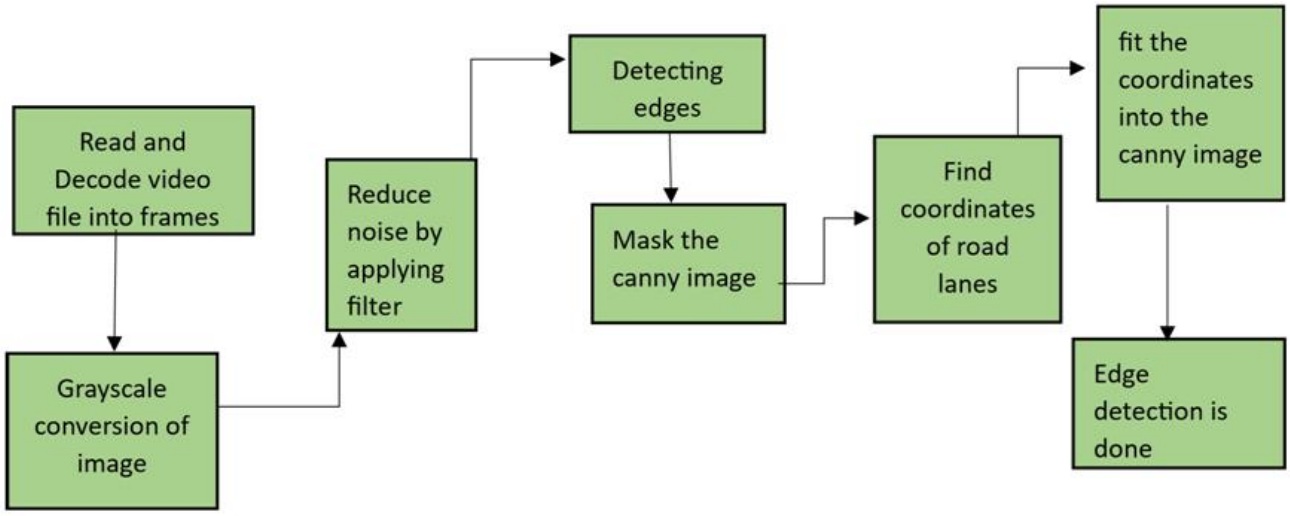

Fig1: System Architecture

a) Color Selection

Here will define a color threshold in the variables red_threshold, green_threshold, and blue_threshold and populate rgb_threshold with these values. This vector contains minimum values for red, green, and blue(R,G,B). For example, Lane Lines are typically White in color, and know the RGB value of White is (255,255,255).

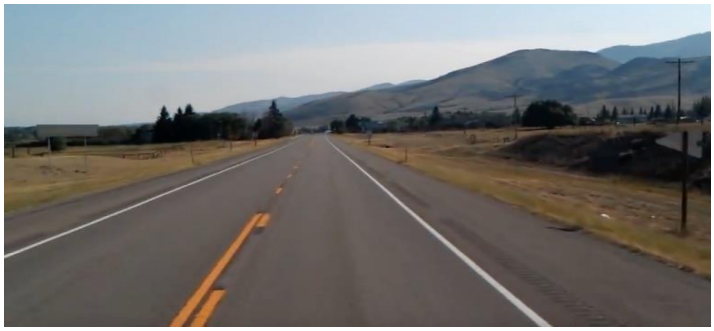

Fig 2:Orginal image

b) HSV color space

HSV is an alternative representation of the RGB color model. The HSV representation models the way colors mix together, with the saturation dimension resembling various shades of brightly colored paint, and the value dimension resembling the mixture of those paints with varying amounts of black or white.

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Fig 3: Color space image

c) Region Masking

Assuming that the front-facing camera that took the image is mounted in a fixed position on the car, such that the lane lines will always appear in the same general region of the image. The next step is to take advantage of this by including a condition that restricts color selection to pixels in the area where lane lines are predicted to exist.

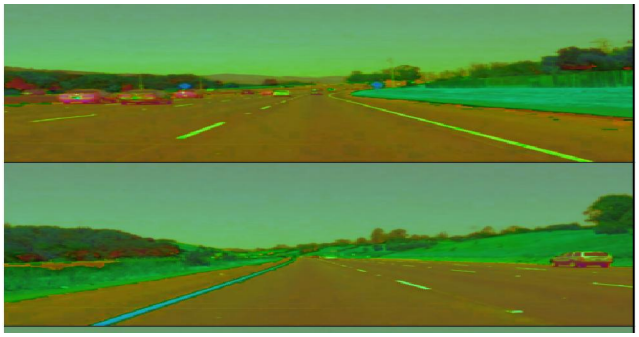

Fig 4: Region masking image

d) Canny edge

Now applying Canny to the gray-scaled image and output will be another image called edges. low_threshold and high_threshold are thresholds for edge detection.

Gray scaling the images

The Canny edge detection algorithm measures the intensity gradients of each pixel. So, need to convert the images into grayscale in order to detect edges.

e) Applying Gaussian smoothing

Since all edge detection results are easily affected by image noise, it is essential to filter out the noise to prevent false detection caused by noise. To smooth the image, a Gaussian filter is applied to convolve with the image. This step will slightly smooth the image to reduce the effects of obvious noise on the edge detector.

The Process of the Canny edge detection algorithm can be broken down into 5 different steps:

1. 1.Find the intensity gradients of the image
2. Apply non-maximum suppression to get rid of spurious responses to edge detection.
3. Apply a double threshold to determine potential edges.
4. Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.
5. Hough Transform Now detected edges in the region of interest, to identify lines that indicate lane lines. This is where the Hough transform comes in handy. The Hough transformation converts an “x vs. y” line to a point in “gradient vs. intercept” space. Points in the image will correspond to lines in the hough space. An intersection of lines in hough space will thus correspond to a line in Cartesian space. Using this technique, it can find lines from the pixel outputs of the canny edge detection output.

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6. Averaging and extrapolating the lane lines
   Multiple lines were detected for each lane line. It needs to average all these lines and draw a single line for each lane line it also needs to extrapolate the lane lines to cover the full lane line length.
7. Apply on video streams

Fig 5: Video streams image

V. CONCLUSION

In-depth research, designing, and planning resulted in the development of a lane detection system that autonomous driving systems can use to identify lanes, providing safer travel for the passengers in the vehicle as well as for pedestrians and other vehicles in the area. The system uses an effective edge detection method to pre-process the image frame and then performs the Hough transform algorithm to highlight the lanes for the user's convenience. The main advantage of this approach is that it can predict the lane configuration on the road without the need for a trained model. Instead, it actively receives the video frames as input and actively recognizes the frame's boundaries, providing lanes as a result to the user. As a result, minimal time goes into developing, training, and testing a dataset. With the help of this technology, users can quickly implement lane detection into their autonomous driving systems.

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