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Lane Line Detection for Autonomous Cars using Python and OpenCV

Mohammed Faisal[1], Ganta Anurag Reddy[1], Balusupati Anil Kumar[1], Dr. D. Ajitha[2]

[1]Students, Department of ECE, Sreenidhi Institute of Science and Technology, Hyderabad, India.
[2]Associate Professor, Department of ECE, Sreenidhi Institute of Science and Technology, Hyderabad, India.
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Abstract: - Driver's safety is one of the main reasons why autonomous cars has been evolving these days. There are many accidents which takes place due to the negligence of the drivers and driving on the wrong lane or a sudden change in the lane. To overcome this problem autonomous car has come into the market. Here the foremost concern is the safety of the passengers and so for that reason lanes detection could be used as a safe driving option. The Lane detection device can be implemented using OpenCV and python programming. This system needs a front camera which can be mounted on a car and using the view from the camera and applying few processes, lanes can be detected easily. The lanes can be extracted using Hough transform through a pair of hyperbolas. The proposed system can be utilized on both painted and unpainted roads. This system can be used in any car for safe lane driving.

Keywords: - Autonomous cars, hough transform, hyperbolas, lane detection, OpenCV.

I. INTRODUCTION

In the present developing world, with the fast improvement of society, vehicles have come to be one of the transportation gears for humans to journey. In the meantime, there are an increasing number of automobiles of all kinds. As an increasing number of automobiles are using on the street, the variety of sufferers of vehicle injuries is growing each year. Autonomous Driving Car is one of the maximum disruptive improvements in AI. They are constantly using our society ahead and developing new possibilities withinside the mobility sector. A self-sustaining vehicle can cross everywhere a conventional vehicle can cross and does the whole lot that a skilled human driving force does. But it's very vital to educate it nicely. One of the numerous steps worried at some stage in the education of a self-sustaining using vehicle is lane detection, that is the initial step is to carry out lane detection with the use of video clips. The lane detection system is very useful for the autonomous cars as the car can travel only in the specified lane and cannot go on the wrong lane. This is very useful for avoiding accidents at large scale. This system proves efficient in finding lanes and can be implemented in less amount.

1.1 Related Work

Fallah [1] mentioned a set of rules for detection of road lanes and the boundaries by using few algorithms. The algorithm transformed the RGB input image to a gray scale images and then the region of interests is selected based on the images. Then after that selection the area which is to be neglected is selected using the algorithms and is deleted from the image. This step is done for all the images. After deleting the unwanted area from the image, then few by using few techniques, lanes are detected for the input image.

Wang [2] has proposed a detection of lane marking set of rules through the use of geometry records and changed Hough remodel. In that set of rules, the captured photograph become divided into avenue component and non-avenue component through the use of digital digicam geometry records.

1.2 Organization

The rest of the paper is structured as follows. In section 2 proposed methodology of the system is described. Implementation of the system is described in section 3. Results in section 4. Lastly, section 5 concludes the paper with future scope.

II. PROPOSED METHODOLOGY

The proposed algorithm is divided into three steps. First is preprocessing, second is ROI selection and third is lane detection [3]. All three steps are important in detecting the lanes. The RGB format image is given as the input to the system. The basic assumption is that the lanes are long and parallel to each other so that the Hough transformation method using the edge selection can be used to detect the lanes [4].

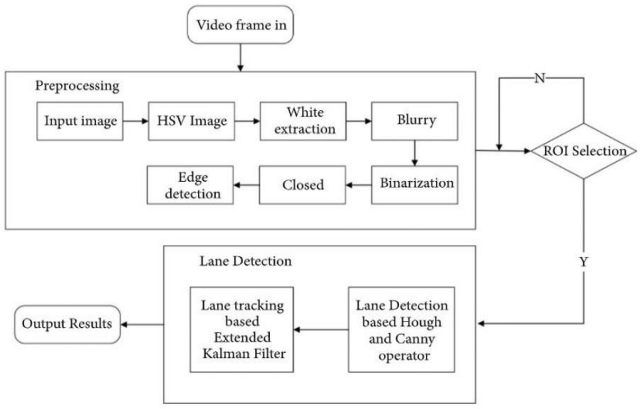

Fig. 1: Block diagram

The lane detection system follows the procedure as follows:

2.1 Pre-processing

Pre-processing is the first stage in lane detection. Here RGB format image is given as the input to the system [5]. Now this image is converted to HSV image. After converting to HSV image, White extraction is done on the image to see the edge of the lanes. If an image is blurry then binarization is done to those images and later Edge detection is done on that image. Finally, Edge is detected in this process.

2.2 ROI selection

A region of interest (ROI) is an area in the image where the implementation of algorithms takes place [6]. This is the area where we have to work on. This can be selected using some algorithms. The unwanted area from the image is deleted and the area which is useful is left in the image. All the algorithms used for detecting lanes can be tested on the ROI selected image.

2.3 Lane detection

The final step after ROI selection is lane detection. Here there are two ways to detect lane. The most conventional one is by using Hough transformation and the other is lane tracking based extended Kalman filter [8].

III. IMPLEMENTATION

The implementation degree of any task is a real show of the defining moments that make a task an achievement or a failure. The implementation degree is described because the gadget or gadget changes being hooked up and made operational in a manufacturing environment. The section is initiated after the gadget has been examined and normal with the aid of using the person. This section keeps till the gadget is working in manufacturing according with the described person requirements.

3.1 Canny Edge Selection

Canny Edge Detection is a famous aspect detection set of rules [9]. It changed into advanced with the aid of using John F. Canny in 1986. It is a multi-degree set of rules and we are able to undergo every degree.

3.2 Noise Reduction

The very first step is to reduce the noise from the image that means removing the unwanted area from the image so that we can work in the area which useful to detect lanes. This is very important aspect of lane detection as it reduces our image into half and we can work on it easily.

3.3 Finding Intensity Gradients of the Images

The noise reduced images is now filtered with kernels in each vertical and horizontal course to take initial spinoff in vertical course and horizontal course. Next the image is round to 1 in all 4 angles representing horizontal, verticals, diagonal directions. From those photos, we are able to discover aspect angle and gradient for every pixels as follow:

$$\text{Edge\_Gradient (G)} = \sqrt{G_x^2 + G_y^2} \quad (1)$$

$$\text{Angle } (\theta) = \tan^{-1}\left(\frac{G_y}{G_x}\right) \quad (2)$$

3.4 Hysteresis Thresholding

To build an intermediate image, hysteresis thresholding compares two images. Two binary images is taken for consideration that have been thresholded at various levels. A function is used for hysteresis thresholding [10]. The higher threshold has a small value of white pixels. The main goal of hysteresis thresholding to notice which edges in the image are really edges and which are not edges.

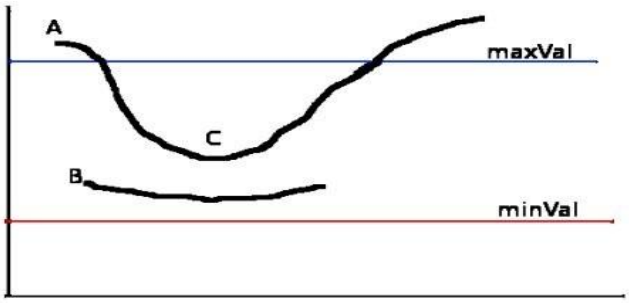

Fig 2: Hysteresis thresholding

3.5 Hough Line Transform

Hough Transform is a method which is usually used in image processing so that any kind of image is detected by using it [8]. Even if the image is broken or distorted, the shape of the image can be detected using this method. Hough line transform method is used to detect lines using Hough transform [9]. Y= mx + c is the equation of line or in a parametric form we can say as r = xcosθ + ysinθ. Here θ is the angle formed by the vertical line and r is the distance from origin to the line. Any line can be represented in term of r and θ. Below image representation is used in opencv

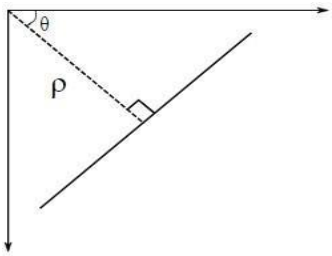

Fig 3: Hough line transformation

IV. RESULTS

Many images of the road with different lanes is used for testing the system and it had resulted above 95% in detecting the road lanes correctly. The system was less efficient in detecting the lanes which are curve but when the road lanes are straight the system was effective. These are the screenshots taken at the time of testing:

4.1 Input Images

Fig 4: Input image

4.2 Color Selection

Color selection is done on RGB input images which first converted the image to grey scale image and then the region of interest masking will be done oin these images. By changing the color of the image, the system can easily detect the lanes. In the above image when the image is color is changed, we can see the lanes easily and the system finds it easy to detect the lanes too.

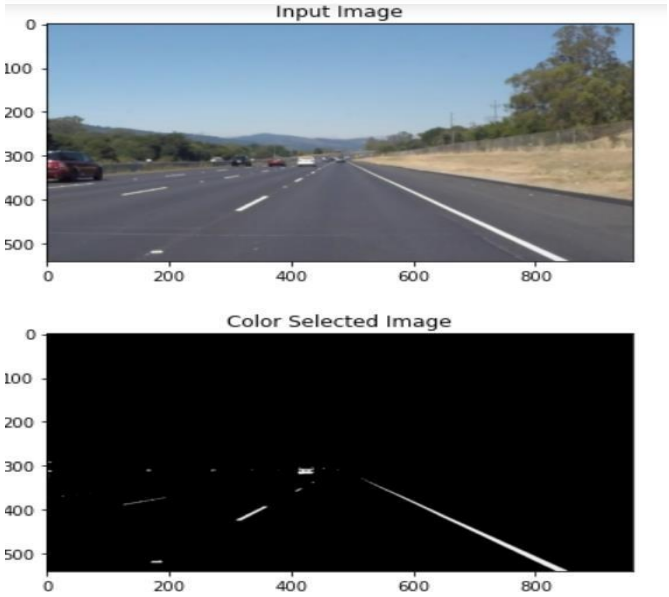

Fig 5: Color selection

4.3 Region Masking

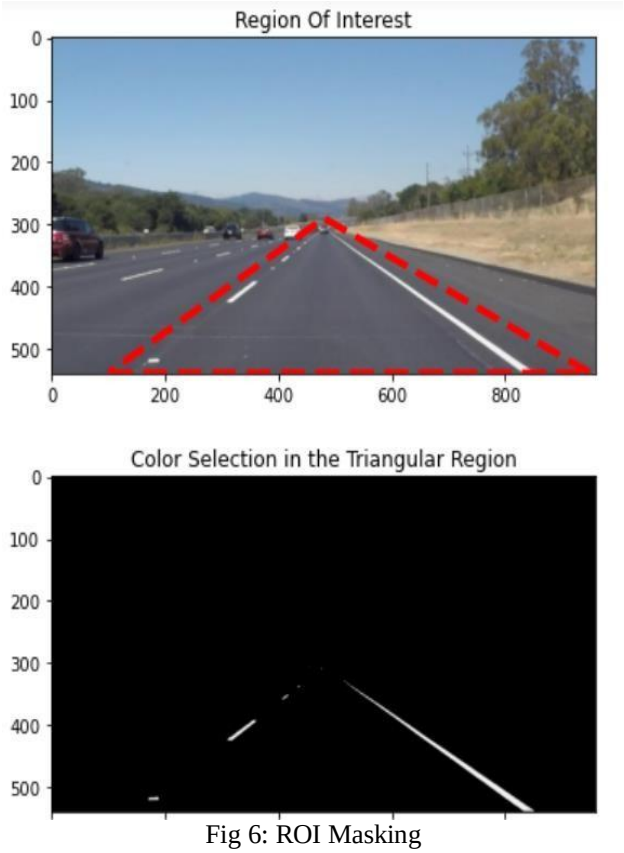

Fig 6: ROI Masking

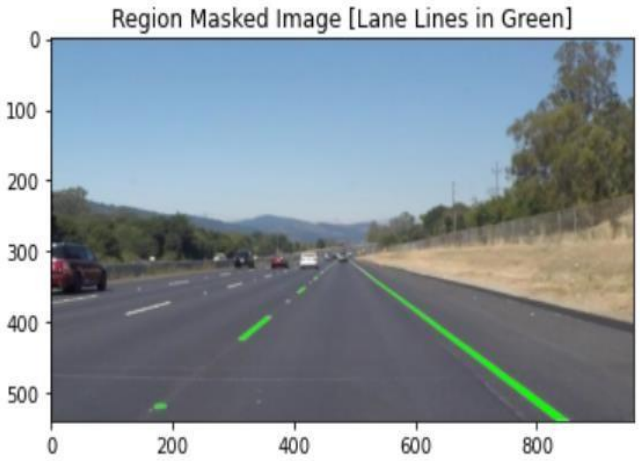

Fig 7: Character selection

Region masking is done to images after the selection of color. And this process removes the unwated area from the image and the area which is useful is kept for further steps.

4.4 Canny Edge Detection

After region of interest is masked on the input image, Now the next task is to determine the edges of the lanes so that we can detect the lane easily. Canny edges detection algorithm is used to notice the edges. This process proves efficient in detecting the road lanes. The images with high threshold pixels are selected and then edge detection techniques are applied on it. Low threshold pixel images are rejected. The output will ne the pixels with white in color and the remaing pixels are in black color. White color pixels is the detected edges by the canny edges detection.

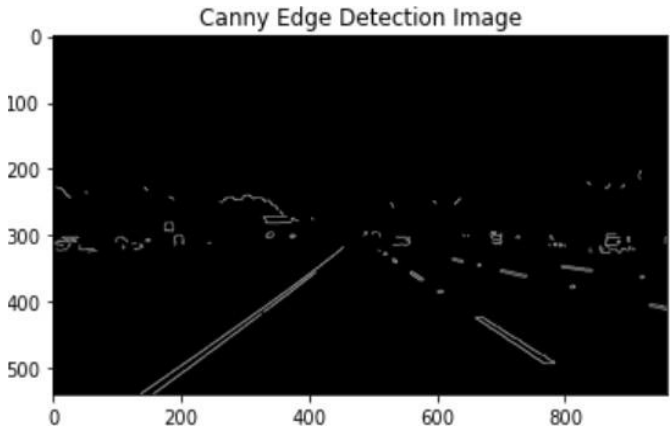

Fig 8: Canny Edge detection

4.5 Hough Transform

After the edges detection technique, next step is to apply the hough transform and detect the road lanes. Here the image is marked as x and y axis. Paul Hough defined this technique and we call hough transform in his honour. This technique is used in every line detection step. Region of interest is marked in blue color and the actual lanes are marked in red color. This method proved efiicient in detecting the lanes in our project. Even slightly curved lanes were detected using this technique.

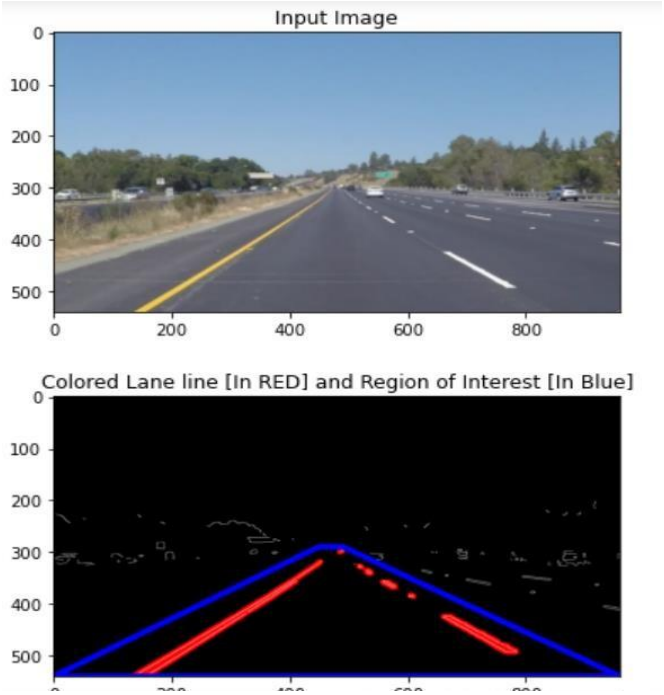

Fig 9: Hough transformation

4.6 Lane line detected for similar type of Images

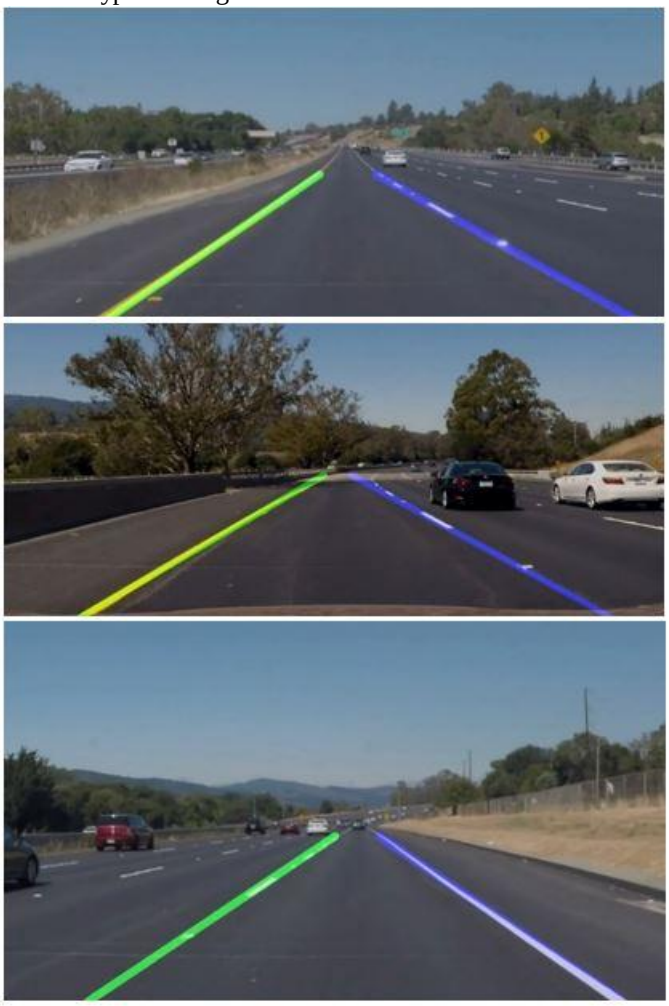

Fig 10: Output images

V. CONCLUSION AND FUTURE SCOPE

The Lane Detection is needed for today's everyday life. Accidents on street are the primary hassle for authorities of any country. The foremost cause of injuries is surprising alternate in lane on speedy using roads. Most of this hassle happens whilst in terrible environmental situation whilst it unsuccessful to discover or withinside the road curves in which detection is just too tedious. Actual time imaginative and prescient-primarily based totally lane detection technique become developed. This system is efficient in detecting the road lanes.

The future scope of the lane detection consists of complicated surroundings thinking of the extraordinary environments inclusive of the all-weather conditions: sunny, rainy, fog, cloudy, mist vivid day light, darker, shadow or whilst there happens barriers and Speed Breakers, humps with inside the road. We can become aware of actual time lane detection. Further we are able to expand this version to the roads which do now no longer comprise lanes.

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