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LANE LINE DETECTION

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ABSTRACT

The transportation business, like the rest of the world, is striving toward development in all areas and departments. With the growing demand for vehicles, it has become vital to make driving easier for drivers by providing various forms of help. Accidents are becoming a more common cause of death around the world these days. Drivers might benefit from the identification of lane and obstructions on the lane while driving by making their journey less focused and laborious. The goal of this project is to create a web-based application that aids drivers while driving by identifying lane lines and obstacles in the way. As a result, the number of accidents is reduced, and travel is made safer and more enjoyable. With the additional support supplied, the user will be able to drive safely.

Keywords: Transport, Lane Line, Assistance.

INTRODUCTION

Road safety is one of the major concerns as approx every year, 1.3 million individuals are killed in automobile accidents around the world (WHO,2021). With the increasing number of automobiles on the road with every passing day, it's of vital importance for every citizen to understand and be aware of the importance of following the road safety rules and regulations. Traffic awareness is imperative while driving on the roads, majorly highways. Apart from traffic awareness there is also a need to make an advent in the applications and technical medium through which driving can be made into an easy effortless work. The transportation industry is growing rapidly due to the fast science and technology advancement This growth in the transportation industry alarms the need for applications to make travelling a safer medium.

Lane line detection is the foundational step in the development of web applications like autonomous driving and intelligent traffic monitoring. These are various emerging applications making attempts to detect the lane line in an accurate manner. This paper presents the explicit algorithms used to detect the lane line for both straight as well as curved paths. So far there have been a number of simple applications attempting to detect the straight lane lines. However, researchers have made attempts and made the detection of multi-lane and curved lines possible using several algorithms. There are still research operations being carried out by many famous researchers in order to choose the precise algorithms that would make the Lane line detection applications a complete application with detection of every type of lane including the hurdles on them.

The autonomous driving mechanism is relatively simple as the precision of lane line detection is low but can detect the correct location of the lane. Whereas the intelligent traffic monitoring mechanism is complicated as it consists of detection of multi lanes with obstructions. Hence, it requires additional preprocessing to acquire much clear lines unlike autonomous driving.

The algorithm works by taking the image's segment lanes as end points that may be used as previous knowledge to estimate the lanes A real-time algorithm is shown below. which is extensively used in detecting lanes and tracking and it can be implemented effortlessly. The main criterion of the algorithm is to detect lanes by using the location of end points. The algorithm is designed to detect both straight and curved lines. Once the location end points are detected for an image at the beginning, the same end points are used for other following images in turn saving resources and processing time. In mat lab-processing, the suggested technique has an average execution time of 0.12 second, and if tuned, it will further improve the speed of operation.(Dong, et al., 2021).

The process of detecting lane lines using a file or an image is a challenging task. The deployment of the application plays a major role which must be executed efficiently. The major criterion is to make the detection process an effective outcome. The mechanism revolves around identifying and analyzing the different lines in different pathways.

This web application gives assistance to pedestrians and drivers on the roads. Consistency of locating the end points is a major factor which reduces confusion while driving. The mechanism allows the vehicular to execute a safe journey.

DESIGN

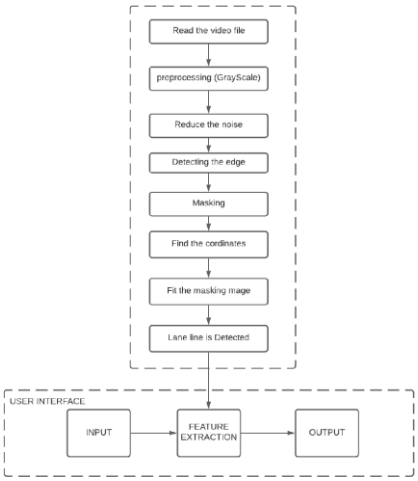


Figure 1 : System Architecture

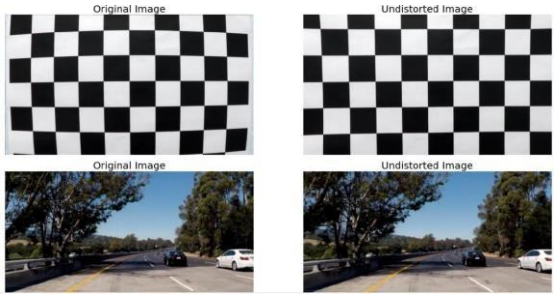
The above figure 1, represents the system architecture of the Lane Line Detection.

The following are the steps to be followed and the goals to be met in order to extract the features of the image or video.

1. Camera Calibration & Distortion correction
2. Perspective Transformation
3. Generate Threshold Binary image
4. Detect Lane Lines: Peaks in Histogram & Sliding Window Technique
5. Detect Lane Lines: Adaptive Search
6. Compute meters/pixel
7. Compute Lane Line Curvature
8. Pipeline
9. Process Video

1. Camera Calibration & Distortion correction:

The main problem is the calibration of color cameras in which the camera parameters are initialized first following the further steps (Herrera C., Kannala and Heikkilä, 2012). The intensity image is used to extract the checker-board corners. Using the known corner positions in the world coordinates and the measured boundaries in the image the homograph for each image is computed. The linear system equations are used for solving each of the homographs which pose constraints on the camera parameters. The initial value of the distortion is set to zero. The depth parameters are initialized in the same manner. The only difference in the depth image is the extraction of the four corners of the calibration plane because the checker-board is not visible in this case. The corners are used only for the purpose of obtaining an initial guess and are very noisy. Then finally the homograph is computed for both parameters. The main features such as principal point, focal length and the transformation are initialized. The expected depth for every selected corner is estimated using these initial parameters. An overview of the linear equation is built by using these estimated depth and measured disparity. Using this will give an estimated depth for the initial parameters as shown in Figure 2 below.

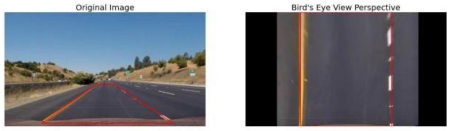


2. Perspective Transformation:

The perspective transformation method is to present the perspective or view of the top view which is compatible with the actual condition as shown in Figure 3 below. (Lane Detection Based on Inverse Perspective Transformation and Kalman Filter, 2018) The main deal of this type of transformation is to eliminate the perspective effect and give it a bird's eye view. The bird's eye view provides the top view of the image which is clearer and easier to be worked further upon. The lanes in the top-most view are parallel and vertical to each other making it very easy and smooth to be identified in the further algorithms. The top view of the image in this case is viewed by using a simple trapezoidal transformation. After the transformation the region of interest (ROI) which is the rectangular region must be converted to a trapezoidal form. The basic idea of perspective transformation is to convert the rectangular shape of the image into a trapezoidal shape. The intensity of the image pixel is set to zero to remove the remainder of the image.

In order to delete the interference of the reflected light efficiently and to locate the lane end markings or locations, the above extracted results have to be processed more. The lane line markings will get unclear and discontinuous in case of low lighted areas and scenarios. To connect the cracked a morphological operator in the straight direction is utilized for lane markers. When the coherence of lane markings is considered. The interference caused due to light sources like automobiles headlights and reflected lights are eliminated. The images will come out to be more approximately vertical strips as the light sources projected in the images appear to be like bilateral symmetry after the morphological dilation operation. Hence the vertical strips can be ignored according to the orientation of every connected region. The angle (in degrees ranging from -90 to 90 degrees) between the x-axis and major axis of the ellipse is defined as the orientation which contains similar second order moments as the region.

Figure 3: Birds eye view



3. Generate Threshold Binary image

Canny edge detector is used for the purpose of generation of threshold binary image. The edges of the image are located first and then by using the edge connection method the ends of the image edges are closed. The partitioned binary image is produced by using the high threshold from the closed image edges. A high partitioned binary image is obtained. Finally, by retrieving the primary binary result with the low threshold binary image a final binarization image is obtained. The binarization of the image helps in reducing the noise of the image along with lowest contrast and non-uniform illumination as shown in below Figure 4,(Ilyas, Luca and Vlad, 2012)

By integrating the extracted lane line features and the gray scale image along with a logical AND operator the gray scale picture of the extracted pixels can be gained for the purpose of easy implementation. The gray scale profiles along with the intensity values transition matches to the Gaussian shape in terms of similarity. In horizontal direction the grayscale profile is convolved with the smoothing Gaussian kernel.

Figure 4: Generating threshold binary image

4. Detect Lane Lines: Peaks in Histogram & Sliding Window Technique

By using the polynomial coefficients namely left_fit and right_fit the points for the left lane and right lane are defined in this phase. A bar that is taller when compared to the other bars in a histogram is called a peak. A single peak or plateau is said to be formed if two or more bars are displaying similar height. Many of the computer vision problems such as object detection are solved by using computing histogram objective function with sliding window technique.

The window sliding over the entire image is helpful in detecting the curved lanes as shown in below Figure 5. A full frame search must be conducted for detecting even a small moving object using the sliding window. The initial sliding window must be detected very carefully, and the moving lines are effectively detected by using the previous lane starting points which are saved in the cache. The sharp curves and the dashed lanes cannot be detected by using the basic sliding window approaches. These sharp curved lanes and the dashed lines are detected by using the multiple sliding window technique. The main criterion is to find the center of the left and right lane which is done after the detection of the left lane and the right lane. The deviation of the automobile from the actual lane is also measured and observed.

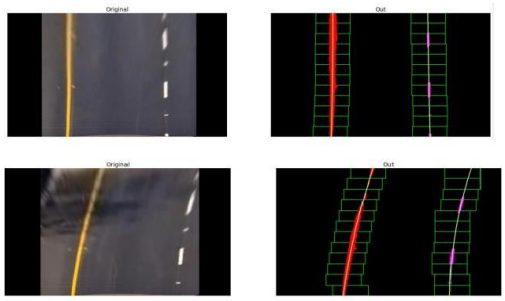


Figure 5 Sliding window

5. Detect Lane Lines: Adaptive Search

The incremental adaptive thresholding trajectory is performed on the detected lane line in turn to produce the binary image using the sliding window technique. In the next step rather than performing a blind search over the binary image produced, the fit lane lines are detected in a margin around the previous fit by using the binary image that has been generated.

6. Compute meters/pixel

Every video consists of many image frames as shown below in Figure 6. A video is a collection of several image frames. The pixel for each image frame is converted into the real-world space and then the meters or the pixels for each image frame are calculated.

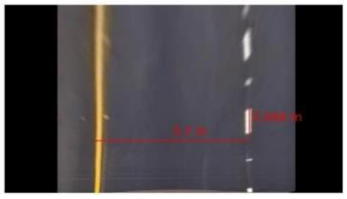


Figure 6: Compute Pixels

7. Compute Lane Line Curvature

The center of the detected lane lines is computed from the offset of the car or the automobile. The curvature of the lane lines is computed in meters. Much estimation of the curvature of the lane and the position of the vehicle along with the lane boundaries are drawn with the utility function.

8. Pipeline

The video is displayed by using the triple split view. With using the pipeline, lane line classification along with the position are both

simultaneously performed in a single network. The image or the video is inserted as the input and a low resolution and high dimensional output is projected with the help of various artificial feature extracted mechanisms and algorithms available. The input of the image is mostly divided into grids as the size of the lanes does not differ much. In the pipeline firstly the location is detected then the classification is performed.

9. Process video

The final video that is processed is displayed as the output. The ways in which the web interface has been developed is explained briefly in this part of the study. The implementation of the web application facilitated by various technologies has been discussed in detail. A predefined database with database handling classes, a set of functions, various machine interaction applications and control over the computer are necessary for successfully building a website. The final layout should be the fulfilment of the requirements along with supporting documentation that provides adequate knowledge making the project a success. The web application can be developed and implemented successfully while performing the desired tasks by using the framework and can maintain continuity for a short period of time. The basic programming syntax over the web and excellent readability to execute a set of code makes Python an incredible language to be used in any framework. The various versions or platforms of python along with the Django framework are available to be accessed easily on many open sources. Web applications can be created on both the server hands and the front end by using the most famous Django framework which is the most ideal tool to be used in any framework.

RESULTS

The results achieved after the implementation of the web application are briefly described in this region of the project work. The validation prediction data is used to obtain the following results. The below screenshots show the lane before and after lane line detection. The below figure 7 depicts the lane line detection through the web application.

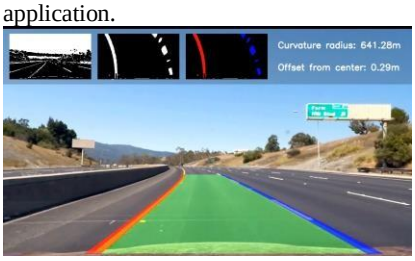


Figure 7: Lane Line Detection

DISCUSSION

The lane line detection web application developed signifies the improvement and developments made to the drawbacks of the previously developed web application that lacked in various ways. The major focus is laid over the extraction of the features which results in detection of the lane line. The already existing systems have been identified to be more complex, time consuming and with lack of accuracy. The already existing system also required additional hardware and software requirements and many algorithms that are designed specifically for the system or the application to work. It also required different modems which are used in the development of the system. There are many approaches required to be proposed to support the developmental changes along with new ideas to be implemented in the existing lane line detection applications and systems. With this, we can conclude that the already existing lane line detection systems are much complex, time consuming and require many resources and approaches along with increased storage capacity in order to extract the features for recognizing lane lines and also for pre-processing and extraction of the database. The process of extraction of images/videos from the database is also difficult and stressful. The features of a lane vary from one road to another as there can be either straight lanes or curved lanes. Some even have hurdles in between that must be detected. There are many systems that have been recognized to lack accuracy in extracting the features which results in failure of recognition of lane line.

The drawbacks with previous system have played a major role in recognizing the improvements and developments to be made for the future systems like enhancing the feature extraction mechanisms by using Hough Transform algorithm. Sliding windows is also one of the new features used to detect the curved lanes which are an enhancement in the latest lane line detection web application. Also, the overall cost of the system is improved but increased due to the new features and mechanisms added.

The main motive of the lane line detection web application developed is to detect both straight and curved lanes through a camera mounted over the automobiles. With the increasing number of automobiles and the advancement in the transportation industry it is very necessary to make driving an easy, effortless, and safest medium. The main idea is to reduce the number of deaths caused due to accidents taking place around the world because of no driving assistance. This application aids the drivers while reducing the number of accidents taking place. The database is pre-processed, and the features of the lane are extracted by using feature extraction mechanisms.

Various features like reduction of noise, minimizing the threshold, gray scaling and region masking are performed over the lane. The process of conversion of a continuous tone image to a different form of the. The image projected after Gaussian smoothing is more on the blur side with only the end points highlighted in detail. The final lane is detected and projected as output. The lane line detection web application is an enhancement to the assistance provided to the drivers in the transportation industry.

CONCLUSION

The drivers can be benefitted by using the lane line detection web application that provides them assistance while driving. This also helps in reducing the number of deaths caused by accidents all around the globe. As the technology and knowledge is increasing, the scientists and researchers are reaching to great levels. This has made possible the various improvements and enhancements made to the previous researchers and developments. One such improvement is the possibility and success of detecting both straight and curved lane lines. The application is built by defining a layout and following each step-in order to meet the desired goals. Hough Transform algorithm is the key algorithm used in order to detect the lane line.

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