

Auto Method for Road Lane Detection Using Image Processing Techniques.

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Abstract

Most of the world population uses road as their transport medium. More than 85% of people uses road transportation so the probability of road accidents is been increasing because of negligence done by people. More deaths are happening and more families suffered by road accidents. When we see Autonomous cars ,they are actually a sign of modern and advance technology implementation for human safety and security actually consist of so many modules in it like Road lane detection, Traffic sign and signal detection, Vehicle and Object detection and many more application modules in it, In this paper we want to do one of the major module that is Road Lane Detection using completely the concepts of Image Processing Techniques and algorithms because most of these uses mixed domains like AI,ML etc.. Using only deep concepts of image processing, we achieved lane detection. Eventually, a critical overview of the methods of the techniques, algorithms are discussed . The proposed lane detection using image processing can detect only for different straight lines and also slight curvy lines only but the implementation is completely Image Processing and no need to learn other huge concepts like AI or ML.

Keywords: Image Processing, Open-cv, Canny edge detection algorithm, Hough line transform, HSL colour selection, Gaussian smoothing(filter), Gray Scaling techniques.

I. INTRODUCTION

Intelligent Transportation System is the today's curious and advance technology the whole world is looking forward to. Many of the billion dollar companies like Google, Uber, Tesla are trying in this field to invent fully autonomous vehicles. Image processing is one of the main drivers of automation, security and safety related application of the electronic industry. Image Significance of image processing and real time embedded systems applications are impacting the modern technology. Among the complex tasks of future self driving safety vehicles is road boundary detection or lane detection. Road Lane detection is the major module in self driving cars. Most of these implementations is actually of mixed domains where the coder needs to understand more advance technologies like AI or ML but in this paper we tried using completely using image processing. If video is the intermediate part in road detection then obviously video is a sequence of images ,if we can process images it means indirectly we are processing video, by the time we reach final processing of image then we directly apply it on each frame of the video ,so the input video will be camera captured video and output will be lane Detected video. We have series of image processing techniques which will be discussed further in detail. After researching many base papers we found so many algorithms and techniques like Canny edge detection for edge detection and Hough line transform for line detection and some filters to reduce noises occurs in images like Gaussian Filters and Gray Scale imaging for smoothing. We proposed an pipeline structure below explaining each algorithm implementation and all other methodologies .Our Model is able to detect most straightened lines as well slight curvy lines, because fully curved lines is out of this scope. We will first take images and make an calculation which is feasible and working fine for all those images then we will pore it on to video stream.Lane line in the test images are in white or yellow we need to specify correct colour selections, so we need to mask the yellow and white colour in the process. The entire paper is about how we are going to detect the road lanes lines So in this paper it's all about how we can achieve this thing entirely using image processing without even knowing knowledge Machine Learning, Artificial Intelligence and any other extra concepts.

The Major Algorithms or techniques used are Canny edge detection and Hough line transform which is an root of this project and once this algorithms are understood we can easily do the implementation part. Vehicle crashes remains the leading cause cause of accident death and injuries in Malaysia and Asian countries recorded tens of thousand of lives and injuring million of people each year. The united Nation has ranked Malaysia with highest number of road accidents, registering an average of 4.5 deaths per 10,000 registered vehicles. Although, a more convincing reason to build intelligent vehicle is to improve the safety conditions by the entire or partial automation of driving tasks. Among these tasks, the road detection took an important role in self driving assistance system that provides data such as lane structure and vehicle position relative to the lane.

Since the detection is based on the video recorder ,camera which is been present in front of the car constantly recording the road video and analysing the things happening in the road.So if video is the major intermediate in the process we can implement image processing techniques because video is a sequence of images.So if we are able to process images,we are indirectly processing video and we can achieve the thing what we wanted to detect all the lines in the video.

II.Problem Description

The main reasons for road accidents is negligence of driver, vehicle inner problems, drowsiness of driver,drink and drive and even the sort of road we are driving .We need some technology that provide safety and security for people whenever driving ,so self driving cars are the sort of vehicles the whole world Is looking forward ,upon all the modules of autonomous cars we are dealing with road lane detection ,its actually an major module ,our problem is to do detection of road lanes using completely image processing without even having knowledge on machine learning and artificial intelligence. Since video is the major intermediate in this process ,if we can process images it is something like indirectly processing video.

Self driving cars need to detect lines on road for safe and secure driving.Since right now there are tries for such vehicle using complex technologies,one needs to know Artificial Intelligence,Machine learning and so on... But we need to give a try to implement this just by using *image processing techniques* with famous algorithms.Just to prove that one who is not having prior knowledge on different technologies must also understand this complex project .This project totally depends on video stream of road,if video is the major concern ,videos are nothing but a stream of images,so processing the images is indirectly but processing an video.All roads are not similar there may be roads with straight line,Broken lines,double straight lines,White coloured lines,Yellow coloured lines etc.. So first we detect the Straightened Lines on the road then we can see for the curvy lines which is actually out of this scope.If we achieved this one we can then also implement other modules like vehicle detection or sign board detection which is comparatively easier than this.

III.Related Works

Learning all the required techniques and particular algorithm is the first task and the major task, we researched so many base papers for this project and learnt two major algorithms canny edge detection and hough line transform ,which is most briefly and compulsorily used techniques in all the papers. In one of the paperto detect road markings and road boundaries various techniques are used including Hough Transform for line detection, Canny edge detection algorithm for edge detection , bilateral filter for smoothing and other purposes.

The best edge detection features are Gooddetection,Goodlocalization,Minimal Response. The main methodology behind the working of bilateral filter is that the two pixels should be close enough to one another.Thus noise,fog,dust and other factors may decrease the accuracy of the embedded systems. one can use bilateral filter and dark frequency prior methods to expand the results. In one more paper they have used an technique called Adaptive road Mask using Vanishing Point detection scheme.This method is so robust and computationally effective and efficient.Like every other paper they also used edge detection and hough line transform at their first step ,then they used an ROI adaptation ,which means selecting only the region of interest of the image consisting of road lanes.In one more paper they did the selection of region in first step only because the images are actually in RGB format and there are so many information on image which is difficult to handle and store ,that's y they are going to take only the region which consists of lanes so that supressing the amount of unnecessary data present in image. Processing the image only on particular region makes the program run faster and makes efficiency of algorithm,after this they actually did Image preprocessing because it consists of so many noise and been involved it to grayscale conversion,gray stretch,median filter for all the removal of noise,they used two types of filtering namely domain filtering and spatial domain filtering and last step is to detect the edges around objects.But in this they also included one more edge detection called spiking neural network because the edge detection is so efficient,which they said more efficient edge detection technique than canny edge detection and then they used Hough line transform for as usual line detection which is one of the image processing techniques.It actually joins two points came from edge detection to make a line.In other paper, they used

the lanebd algorithm does is to remove the distortion and adjust the orientation using a camera calibration routine and chessboard images, then image is converted to colour spaces like HSL conversion, HSV conversion etc. and they used to extract white and yellow line boundaries, then they marked the region in rectangle for better visualization. Then they did an spatial gradient computation on image using Sobel Operator. The operator includes an averaging mechanism, therefore, it has some smoothing effect on the image's random noise. The operator includes as well as the differentiation of two rows or two columns, therefore, the edge elements on both sides are significantly enhanced, and consequently, the edge looks thick and bright. Sobel operator is less sensitive to the existing noise in images as it has a smoothing effect (Gaussian filtering). A perspective transform maps the points in a given image to different and desired image points with a new perspective. but this project is even able to even detect lane curvature also which is actually an toughest implementation, because it is actually out of image processing scope, they implemented deep computer vision techniques. Then finally they did HSL conversion, HSV conversion, LAB conversion and YUV conversion etc. and then they did lane boundary detection pipeline and then atlast they did parameter tuning by testing with so many images and calculations correction to maintain accuracy for all the different images and only to incorporate this to video. By all the above we took the required informations and proposed an pipeline structure so that implementation part will be easy.

IV. Methodology and Materials

a) Algorithm

Two algorithms which is been observed to be present in all the papers are Canny Edge Detection and Hough line transform.

Canny edge detection: The Canny filter is an edge detector with multiple phases. In order to measure the strength of the gradients, it uses a filter based on the derivative of a Gaussian. The Gaussian reduces the noise effect present in the picture. Then, by eliminating non-maximum pixels of gradient magnitude, possible edges are thinned down to -1 pixel curves. Finally using hysteresis threshold, edge pixels are maintained or removed.



Fig.a.Canny edge output

Hough line transform: Using an appropriate edge to find all the edge points in the picture scheme for detection. Quantize the space of m, c into a two dimensional matrix H with suitable levels of quantization. Initialize the H to zero matrix. The outcome is a histogram matrix.



Fig.b.Hough line Transform

Output of Road Lane Detection: After performing all the algorithms and techniques we will able to detect the lanes of the road.

The below diagram shows the accuracy and lane detection of test images.



Fig.c.Output of Test images

b) Methodology

After overall look up of so many techniques we choosed an feasible, efficient ,effective methodologies and algorithms we prepared an pipeline structure for the implementation part.

Lane lines on roads are actually in white color and yellow. We need to select the most fitting color space that clearly highlights the lane lines.

We decided to applyHSL color selection because after researching all we found out that using HSL will be the best color space to use and we mask their yellow and white color space.Then we apply Canny Edge detection for edge detection and the algorithm has been already explained in short above.We're interested in the area facing the camera, where the lane lines are found. So, we'll apply region of interest to cut out everything which we not required else.The Hough transform is a technique that can be used within an image to separate features of a specific shape.For each lane line, we have several lines detected.

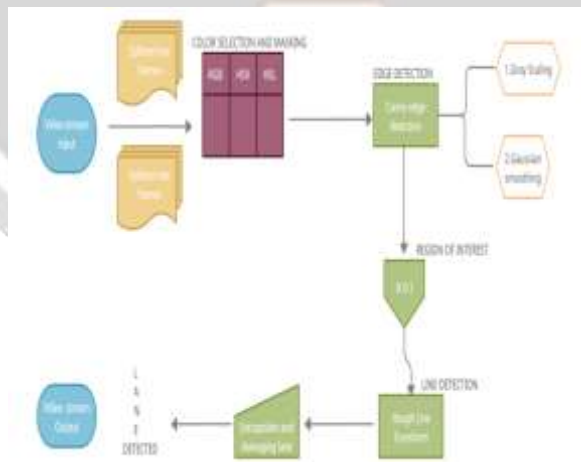


Fig.d.Proposed Pipe line architecture

Now to detect lines from video stream we just apply all the above functions so that it will be seen as video processed. First we will test one image with road lanes and make it work and then we increase the number of test images and modify and alter the code as is and make it more universal. Once we got output on all images then we will start applying it on different videos, first on solid white lines and then on solid yellow lines and then on our challenging video slightly curved lane detection .By the time we reach our final stage we will be able to detect straight road lanes accurately and slightly curved ones .

Testing with more test images will be able to increase accuracy of the project and for the better real time implementations also. All the methods and techniques were chosen by all the base papers we studied and researched, each methodology is dumped by different papers.

Variation of color selection: There are 3 types of color selection RGB, HSV, HSL. After seeing all the three color selection we came to conclusion that HSL color selection is more efficient both in performance and accuracy. The below diagram illustrates the difference between all three color selection.

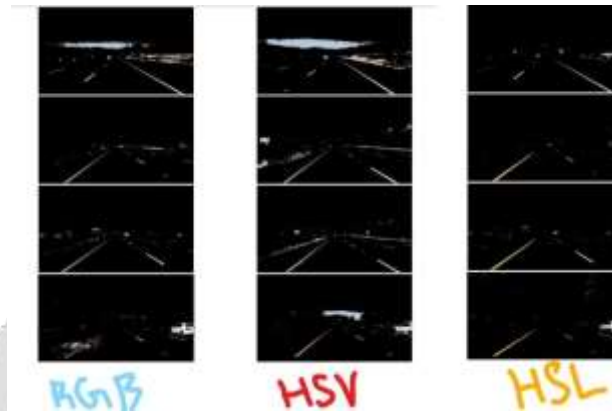


Fig.e.Variation of color selection

V. CONCLUSION

From the above all paper, We chosen best technologies and learnt the importance of famous algorithms. The working scenario has been learnt and each paper has its own uniqueness and has its own advantages and disadvantages as well. By considering all those things we wisely took the necessary technologies and methodologies required for our project. There are many challenges to be addressed, to overcome all these challenges we have proposed an pipeline architecture which will lead to the proper output and destiny of our road lane detection. We choosed canny edge detection and houghline transform, The reason to choose those algorithms is that they are very fast efficient and help us for real time embedded implementation. We also applied so many other image processing techniques like filters, color, selection, scaling images for different purposes in our project which determines the result.

VI. REFERENCES

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