AN EFFICIENT LANE DETECTION USING DEEP LEARNING MODEL

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Abstract—Introduction ofSelfdriving cars hasled to the requirement of developingnew technologies and concepts related to it. LaneLine Detection is one amongthem, whose variants also has their own applications in different computer visionmodels. The objective of the work is detecting lanes that describe the path for theself-driving cars. Lanes are detected with the help of the white lines that are in bothsides of the lanes. The core idea is to use frame masking and houghtransform.masking can be used for detecting the white lines and hough transform which ingeneralisusedfordetectinggeometricalshapeswillbeemployedforlanedetection. The developed model will be used in detecting the lane from a video thatcontains road.

Keywords—LaneDetection,FrameMasking,HoughTransform.

I. INTRODUCTION

1.1 NeedForLaneDetection

Autonomousvehicles are the one that are capable of operating themselvesandthey don’t need any human intervention. This makes the vehicle to sense all things thatsurroundsitwhichincludesdetectionoflanesintheroad.Detectingthelanesbecomesthe inherent part of other works such as the controllingthesteeringandbreaking.The problem of detecting the lane can be formulated as, given an image as shownbelow,theobjectiveofthemodelistodetectthelane.

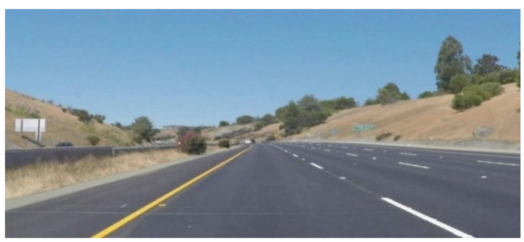

Figure1.1Imageinwhichthe Laneshouldbedetected

1.2 Objectives

Todesignthefollowingmodels

- LaneDetectionmodelbasedonHoughTransformation
- ADeeplearningmodeltodetecttheLanes

While this phase of the work concentrates on the designing of a model based on houghtransform.Thesecondphaseoftheworkwouldconcentrateondesigningthedeeplearningmodel.

1.3 DeepLearning

Deep learning is the concept that varies from the earlier machine learning modelsin such a way that the performance of the system varies with the amount of data that hasbeen used for training the system. The following figure 1.2 depicts it. It is inferred fromthe figure that the performance of the older machine learning model learns till a rate andthen it becomes constant,there will be no improvement in the performance with respecttotheincreaseinthesizeofthetrainingdata.Butincaseofdeeplearningtheperformance of the systemconstantly increases with the increase in thesizeof the data.

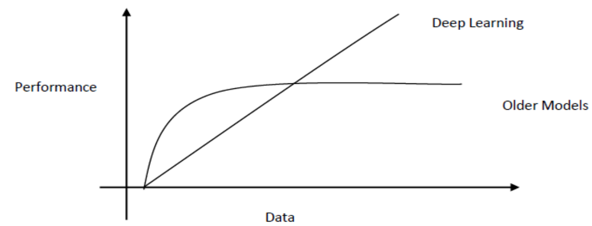

Figure1.2Advantageofdeeplearningmodelthantheothermodels

II.PROPOSEDSYSTEM

The proposed system is twofold, it includes a model based on hough transform fordetecting the lanes and designing of a deep neural network model for the same purposeandidentifythebettermodel.Thisphase of the workconcentrates on designinga model for detectinglane in an image.

2.1 SystemArchitecture

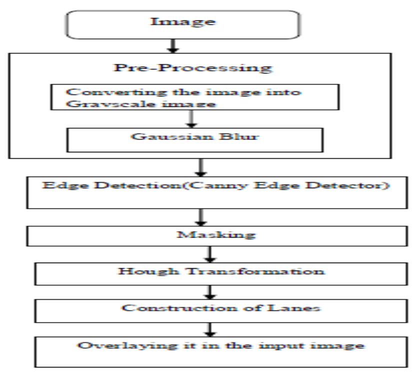

Figure2.1 Systemarchitecture

III.SYSTEM MODULES

Themodulesinclude

- Pre-Processing
- EdgeDetection
- Masking
- DetectionandConstructionofLanes

3.1 Pre-processing

Pre-processing includes two steps, converting the image in to gray scale image andapplyingGaussianblur.Theoriginal image given asinput is shown belowfigure 3.1.1.

Figure3.1.1Input Image

Thefirstprocessistoconverttheimageintoasinglechannelimagecalledasthegrayscaleimagewhich is showninbelowfigure3.1.2.

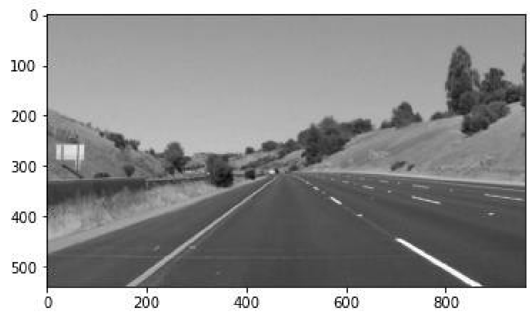

Figure3.1.2GrayScaleImage

3.2EdgeDetection

The next step is to detect the edges. This is done with the canny edge detectionalgorithm. The primary objective of the canny edge detection algorithm is to extract thestructural information that is more useful than the other information in the given image.Canny edge detection is applied in various computer vision applications. The objective ofthecannyedgedetectionalgorithmisasfollows.

- Thealgorithmshouldbecapableoffindingallmostalltheedgesinthegivenimage
- Everyidentifiedimageshouldbemarkedonlyonceandthefalseedgesshouldbeavoided.
- Theedgepointdetectedfromtheoperatorshouldaccuratelylocalizeonthecenteroftheedge.

The stepsinvolved in thecanny edge detectionalgorithmare as follows.

- SmoothingofanimagewithGaussian filter
- Findingtheintensitygradientsoftheimage
- Gettingridofspuriousresponsetoedgedetectionbyapplyingnon-maximumsuppression
- Determiningtheedgesbyapplyingdouble threshold
- Trackingtheedgesbyhysteresis
- Removingtheweekedges.

we can find edge gradient and direction for each pixel asfollows:

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

$$\text{Angle}(\theta) = \tan{-1}(Gy/Gx)$$

Gradient direction is always perpendicular to edges. It is rounded to one of four anglesrepresentingvertical,horizontalandtwodiagonaldirections.

Non-maximumsuppression

The image magnitude produced results in thick edges. Ideally, the final imageshould have thin edges. Thus, we must perform non maximum suppression to thin out theedges. Non maximum suppression works by finding the pixel with the maximum value inanedge.Non-maximumsuppressionisappliedtofindthelocationswiththesharpestchangeofintensity value.Thealgorithmforeachpixelin the gradientimageis:

1. Compare the edge strength of the current pixel with the edge strength of the pixelinthepositiveandnegativegradientdirections.
2. If the edge strength of the current pixel is the largest compared to the other pixelsin the mask with the same direction (e.g., a pixel that is pointing in the y-directionwill be compared to the pixel above and below it in the vertical axis), the valuewillbepreserved.Otherwise,thevaluewillbesuppressed.

Insomeimplementations,thealgorithmcategorizesthecontinuousgradientdirections into a small set of discrete directions, and then moves a 3x3 filter over theoutput of the previous step (that is, the edge strength and gradient directions). At everypixel, it suppresses the edge strength of the center pixel (by setting its value to 0) if itsmagnitudeisnotgreaterthanthemagnitudeofthetwoneighborsinthegradientdirection.

The result obtained with the process of canny edge detection is given in the followingfigure3.2.

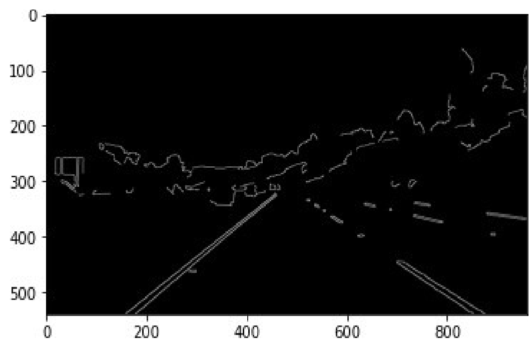

Figure 3.2 Canny Edge Detection

3.3Masking

Itcanbeobservedfromtheaboveimagethat,inadditiontotheedgesthatrepresents the road lanes, there are also various other edges.Those edges are not regionof concern for the road lane detection. The objective of masking is to remove those edgesand extract only the edges that represent the lane of the roads. In order to extract theregion of interest a polygon is formed that covers the region of interest. The rest of thepixelssurroundingthepolygonareremoved.Theresultingimageisshowninthefollowingfigure3.3.

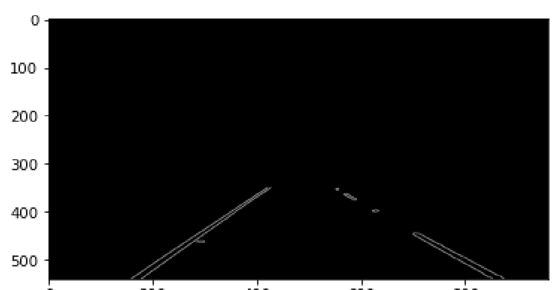

Figure3.3Masking

3.4 ConstructionofLanes

Hough transform is a method that is commonly used for detecting various shapessuch as the lines, circles that occur in an image. It is used here in order to find the lines inthe image which is masked in the previous step. The concept that is followed in detectingthelinesisasfollows.

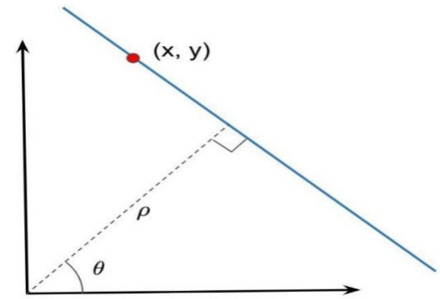

Figure3.4.1 Polar coordinaterepresentationofthesystem

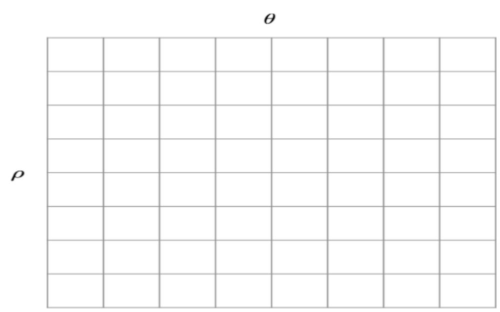

Figure3.4.2AccumulatorusedinHoughlinetransform

Once the accumulator is created, every cell of it represents the line.The idea isthat if there is a visible line in the image, an edge detector should fire at the boundaries ofthe line. These edge pixels provide evidence for the presence of a line. The output of edgedetectionisanarrayofedgepixels $[(x_1, y_1)\ (x_2, y_2)\ldots(x_n, y_n)]$. Using this technique, we can find lines from the pixel outputs of the canny edge detectionoutput.Theresultisshown inthefollowingfigure3.4.4.

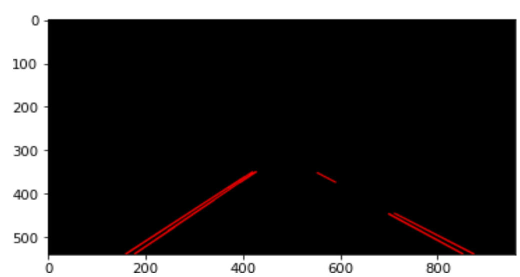

Figure 3.4.3Houghtransformation

Theextrapolatedlineisoverlayedontheoriginalimageandtheresultingimageisgivenin 3.4.5.

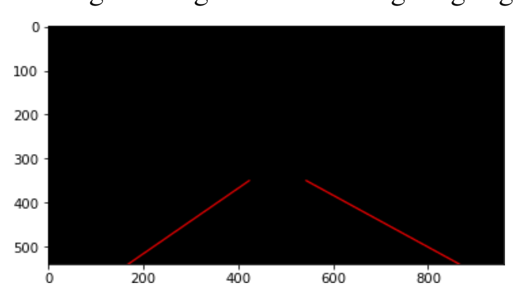

Figure3.4.4Constructionoflanes

Figure 3.4.5Overlayedimage

IV.CONCLUSION

A model for detecting the Road lanes in the images is developed in this work. Itusestheconceptofhoughtransformforlanedetection.Thestepsthatprecedethatinclude pre-processing such as converting the image togray scale and edge detectionwithcannyedgedetectionmechanism.

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