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## Design of Vision based Intelligent Lane Detection and Tracking under Different Conditions

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### Abstract

This work gives a detailed account of putting into effect of a intelligent based Kalman filter and hough transform algorithm to detect and track a lane. In this model the camera is put on the vehicle(car) by recorded the real time video. The video is taken by camera will go to the different image processing steps which includes Intensity image, In Image processing steps RGB to Gray conversion is important in this paper because our challenging task is to detect and track lane under different light ,different weather and different lane conditions. In every conditions the parameters of RGB and Gray image are varied and due to this the performance of detection and tracking of lanes are poor. Hence we design a intelligent system by using fuzzy. First Find out the parameters of RGB and Intensity image of all the scenarios and apply to the fuzzy system for better performance of detection and track of lane. After that changing size, Interested region , Edge detection , hough transform and Kalman filter algorithm used to detect and track Lane. Lane detection and lane tracking techniques various mathematical tools which are used to detect and track lanes clearly. So many lane detection and lane tracking algorithms used their such as Hough transform, Ransac , Particle filter The most commonly algorithms used are Hough transform and Kalman filter algorithm. In this work of making observations we give out with MATLAB SIMULINK model for Hough transform and kalman filter algorithm which are used to detect and track lanes.

In this work of making observations work as first started to make a real time video of Lane taken by camera in dissimilar light, weather and road conditions is processed by using image processing algorithms , Edge detection, Lane detection, Lane tracking to detect and track lane. In this work of making observations we give out with MATLAB SIMULINK design to be for image processing steps and Sobel edge detection algorithm, Hough transform and kalman filter algorithm.

### Keywords

Intensity, BI Method, Sobel Algorithm, Hough, Kalman Filter

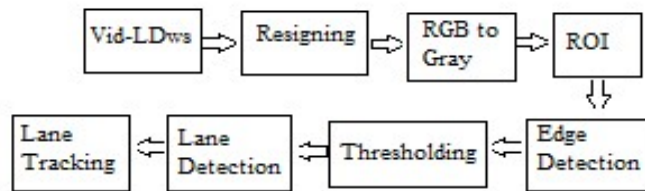
### Introduction

Lane detection and lane Tracking is important part of the LDWS because most of the traffic accidents were caused due to the vehicle move towards the Lane either left side or right side unintentionally and also the negligence of the driver. The purpose of Lane detection and lane tracking is to reduce the number of traffic accidents and to improve the safety. The hough transform is used in image processing for extracting the features of an image. It finds the imperfect instances of an object within a group of shapes by a voting procedure. This procedure is done in parameter space, where object candidates are obtained as local maxima in an accumulator space that is explicitly constructed by the algorithm for computing the Hough transform. Kalman Filter is used for estimation and prediction of steps.

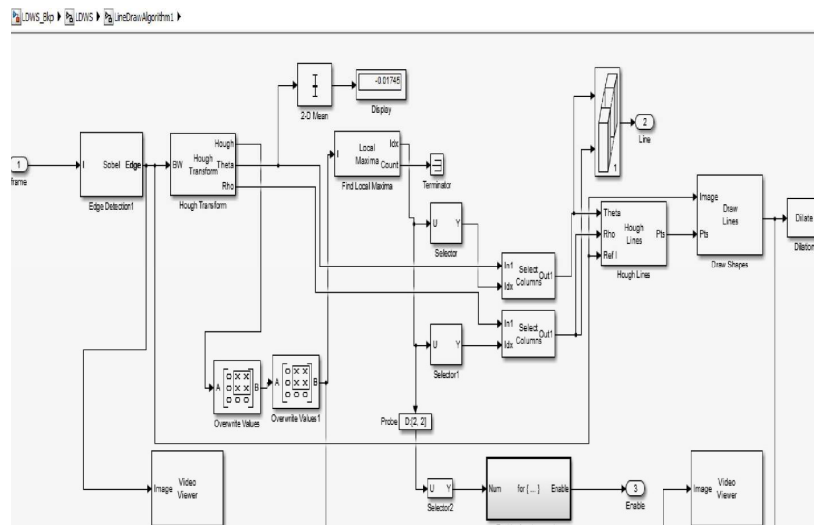
In Edge detection method have a different algorithm which are used to find out the dot in an video at which the contrast of image varies clearly. Sobel apply an video to make less the value of data to be treated and may therefore filtering the information that is used for further Image algorithms. The aim of edge detection algorithm is to that any noise present in an image can be distorted easily and improving the SNR ratio. Hence Sobel algorithm is used to give correct edge detection with fine and smooth image also the second aim of Edge detection are used to making outpoints in an image at which the image contrast changes sharply. In this algorithm first step is able to find out the edges of each portion which are present in the videos and to make less the value of data to be treated, yet it gets important data about the structure of image in the scene. For designing a computer Vision based system it is necessary to detect a correct edges , to detect correct lane and to track a lane clearly. Various approaches are available for lane tracking ,Lane detection , and edge detection in a real time videos. In Edge detection methods detection the convolution of image with an kernel. More number of edge detection Kernls available, which are used to design different structures. Different parameters includes in

the choosing of an edge detection operator include Gradient Magnitude, Angle of line, softening the image and Threshold. Kernels can work for Parallel, upright, or crosswise edges. In Lane detection methods apply Hough Transform to Edge detection image and to find Rho and Theta Values ,Create accumulator and Find local maxima(Hough Space) and Draw the lines back to the Image. In lane tracking methods Initializes the State matrix & Measurement matrix size and calculated transition matrix. Use white Gaussian noise for our system. Using this noise model, we have calculated the error for state and used in estimator to generate the predicted state using that measurement noise and Variation of detected lines along the lanes are averaged out by the Kalman filter by adding up the measurement error and previous state As an outcome of that, the operation of the system in different Light, Weather, and Road conditions and used in detection of Line marking to get well the safety and doing work well on the road and also to get reduced the number of vehicle accidents. The persons making observations are getting greater, stronger, more complete camera-based systems to get well vehicle safety. LDWS uses a camera to computer viewing output the length at intervals the car and Line marking and, if the vehicle changes in the direction of the way between lines markers, the system gives suggestion to ready driver for keeping vehicle back into its way between lines. [1,2,3].

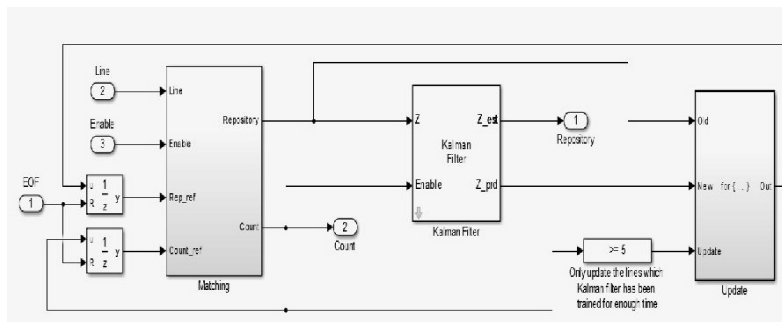
**System Modelling and Method:**



**Figure 1: Lane Detection and Tracking System**



**Figure 2: Simulink Design of Lane Detection**



**Figure 3: Simulink Design of Lane Tracking**

In actual way LDWS , finding out the Line marking and the follow the Lane or line and deliver the warning to the driver to avoid the accidents. Generally, for systems the find out the line and tracking of Lane is difficult problem. In many times LDWS could not find out the low-quality line markings because of different light , climate, Lane , road conditions and darkness effects are also affected for video transmission. Since the aim of this model to keep the protection from harm , and safe life using camera. The fig.1 shows block diagram of Lane detection and lane Tracking model. MATLAB Toolbox is used for making a model and its analysis. Lane detection and Lane tracking is complicated problem under different conditions. To resolve this problem first the edge detection is difficult for colour image so simulation of RGB video is first convinced to grey video. In RGB and gray image has different features for different conditions.so analysis all the parameters ie Max, min, Mean, standard deviation , variance and apply to the Fuzzy system to improve the performance of lane detection and lane tracking. Then Bilinear interpolation method used for resizing the size of image for increase the processing speed. ROI is apply for faster Lane detection process. Sobel algorithm used for finding the urges. The Simulink Tool box gives out with all phantasm which are present in actual LDWS for traffic network. The camera is mounted on the vehicle in this way that the direction of angle is 45 degree towards the ground, so that the camera only will take a video of the lower side ie the video of road, it will take the videos of only lane the other portions are not included which reduced the processing time ,complications and it gives the better performance of the model. The different simulink blocks go through Image that are applied to input video taken by camera.

### Colour Video to Gray Video Conversion

In RGB image consists of 24 bits in each pixel because in RGB image contains three colors Red, Green and Blue.ie every pixel has particular color has an the weighted of RGB color. In RGB image producing a complexity at the time of Pre processing stage. Also for find out the boundaries of lane are complicated , edge detection becomes difficult and required more memory space , therefore effects the passing time. Therefore to reduce the time required for processing the color image, RGB were converted into grayscale. RGB converts pixel of 24 bit image to a pixel of 8 bit Grey image. The formula for finding a Grey scale Image is a average of the picture element of R value $\times$  0.33 picture element of G value  $\times$  0.51 picture element of B value $\times$  0.16 and the final output is obtained of gray value for the corresponding picture element[6]. In color video to gray video Conversion. In this model Weighed method is used for converting color video to Gray video.

$$By=0.33Br+0.51Bg+0.16Bb$$

Br, Bg and Bb - Brightness of R, G and B level.

By- Brightness of equivalent gray level video of RGB .

### Region of Interest (ROI)

ROI video is processed only on input video taken by camera. It will apply only whatever portions are necessary will be keep for further line marking steps and rest of frame will be put out as of no use. ROI is necessary because processing time is reduced and speed will increase. ROI means to cutoff the unwanted portion.Fig.3.7 shows a model making for, an real time video taken from a vehicle. In ROI only small video is taken so that size is reduced and in memory less space are required. By applying ROI ,pixels value doesn't varied and doesn't affect the performance of the model .it will improves the speed , processing time will be reduced, complex condition will be completely reduced and will be used for Line detection stages. If smaller ROI selected , for finding the Line marking s will be easy.

### Resizing

Our videos are the so many unnecessary information available so that correct shape we required them to be, so it's necessary to know how to reduce the size of an video and how resizing works. When the size of video is reduced , its picture elements of data is changed. Sometimes to reduce the size of video without changing the number of pixels. For example, the size of video made smaller,, any unnecessary data present into the pixel will be removed. There are so many methods for resizing the video or Image size. B.I algorithm is used for this purpose. In this process change of bit in a pixel of video is possible. The two Dimensional array is scaled in to m by n matrix which are used to find out the resolution of video. B.I.method takes a assign value of weighted sum of the 4 nearest picture elements .Each weight is proportional to the distance from each existing pixel. Basically It applies weights based on distance of the four nearest cell centres smoothing the output. The BI value is find out if all pixel is of same distance then the value is average divided by four. When all known pixel distances are equal, then the interpolated and it performs in two directions.[7]

### Edge Detection

Edge means simply change the contrast brightness in video. Edges are occurred between boundary of two different regions. Edge detection is used to recover the useful information from regions. In Edge detection where algorithm to find out the pixel value where the brightness changes sharply. Edge detection techniques various mathematical tools which are used to making outpoints in an image at which the image contrast changes sharply. So many Edge

detection algorithms used their such as search-based and zero-crossing based.. The most commonly search based algorithms used are Sobel and canny's edge detection algorithm. In this work of making observations we give out with MATLAB SIMULINK model for Sobel algorithm which are used to detect edge.

**Sobel Edge Detection Algorithm**

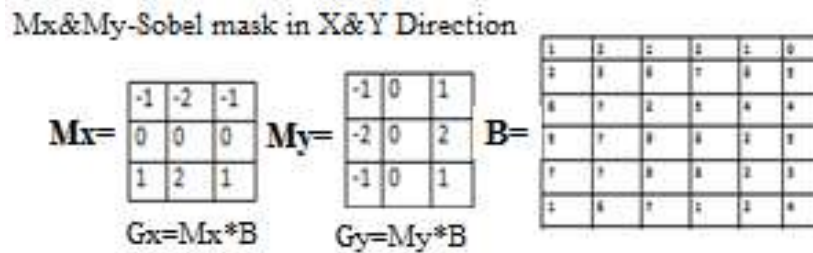
In Edge detection methods detection the convolution of image with an kernel .More number of edge detection Kernls available, which are used to design different types of edges. Various parameters included in the choice of an edge detection operator ie Gradient Magnitude, Angle of line, softened the image and Threshold. [8]

Process of Sobel Edge Detection :

1. Apply Gauss.filter for softened the image
2. Apply first derv.operator for calculating good edges.
3. Find direction of gradient
4. Calculate Non maximal suppression
5. Apply thresholding.

Magnitude of the G- $|S| = \sqrt{G_x^2 + G_y^2}$

Angle of Line- $l = \tan^{-1}(G_y/G_x)$



**Figure 4: Gradient in x & y Direction**

**Threshold**

Finally find out the threshold value of the grey video. Threshold value is calculated from gradient magnitude and apply threshold for find out correct pixel value.

**Lane Detection**

Hough transform block find lines in an image. Hough transform block precedes the Hough lines which uses the output of this block to find lines in an image.[9,10]

Process of Lane Detection:

1. Edge detection image
2. Apply Hough Transform to find Rho and Theta Values
3. Create accumulator
4. Find local maxima (Hough Space)
5. Draw the lines back to the Image

**Lane Tracking**

Kalman Filter is used for tracking of lanes.

Process of Lane Tracking:

1. Initializes the State matrix & Measurement matrix size.
2. Calculated transition matrix.
3. Use white Gaussian noise for our system.
4. Using this noise model, we have calculated the error for state and used in estimator to generate the predicted state using that measurement noise.
5. Variation of detected lines along the lanes are averaged out by the Kalman filter by adding up the measurement error and previous state.

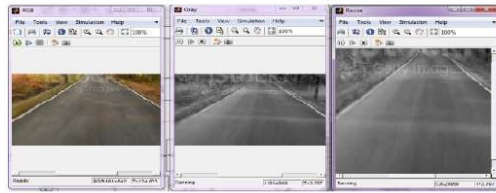
**Features of Different Conditions:**

Different Scenario/ Features	Day Condition clear Lane		Night Condition Dark night		Fog Condition- Dense fog		Dawn Condition		Rainy Condition		Shadow day Condition		Fog Condition- Heavy fog	
	Lane	Road	lane	Road	Lane	Road	Lane	Road	Lane	Road	Lane	Road	lane	Road
Intensity														
Max	255	154	90	20	99	75	164	83	148	129	71	40	90	75
Min	108	150	14	18	65	65	63	74	87	116	0	36	75	72
Mean	149	152	42	18	77	71	109	79	128	122	27	38	81	73
STD.DEV.	32	1	26	0	8	2	37	2	12	3	17	1	3	1
Mode	134	151	16	18	69	72	66	80	129	123	32	39	79	74
Var.	255	0	255	0	66	6	255	5	136	9	255	0	10	1
R-Plane														
Max	255	157	91	21	100	82	162	83	146	128	72	41	83	68
Min	121	152	16	19	63	69	62	71	89	114	0	38	68	64
Mean	159	154	43	19	77	77	107	77	127	119	28	40	75	67
STD.DEV.	31	1	26	0	8	3	38	3	11	3	17	1	3	1
Mode	151	153	18	19	69	78	64	79	126	120	34	40	73	67
Var.	255	1	255	0	64	7	255	6	118	9	255	0	9	1
G-Plane														
Max	255	154	89	19	100	73	166	85	151	132	72	40	92	78
Min	105	150	13	17	65	64	66	77	90	119	0	36	77	75
Mean	147	151	41	17	77	69	111	81	130	125	28	39	83	77
STD.DEV.	32	1	26	0	8	2	38	2	12	3	17	1	3	1
Mode	132	151	15	17	69	70	68	83	133	127	35	39	82	77
Var.	255	1	255	0	68	6	255	5	142	9	255	1	11	1
B-Plane														
Max	252	152	90	20	98	67	155	79	138	119	65	34	94	77
Min	77	146	14	17	63	58	55	68	71	106	0	30	78	72
Mean	136	148	41	18	77	63	101	73	117	112	22	32	84	75
STD.DEV.	36	1	26	1	8	2	37	3	13	3	17	1	4	2
Mode	146	147	16	17	69	65	58	74	119	113	0	32	81	77
Var.	255	1	255	1	62	5	255	8	162	9	255	1	13	3

**Table 1: Various Parameters of Lane and Road under Different Conditions**

**Results**

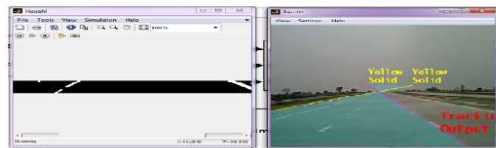
**A. Result of Day Condition**



Result 1. RGB Image Result 2.Gray Image Result 3.Resizing



Result 4. ROI Result 5.Edge detection Result 6.Hough space



Result 7.Lane detection Result 8.lane tracking

**Figure 5: Output of Lane Detection & Tracking (Day Condition)**

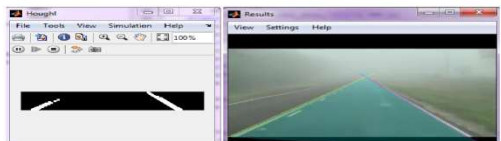
**C. Result of Fog Condition**



Result1. RGB Image Result 2.Gray Image Result 3.Resizing



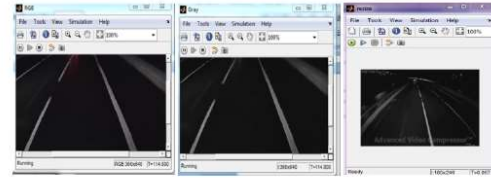
Result4. ROI Result 5.Edge detection Result 6.Hough space



Result 7.Lane detection Result 8.lane tracking

**Figure 7: Output of Lane Detection & Tracking (Fog Condition)**

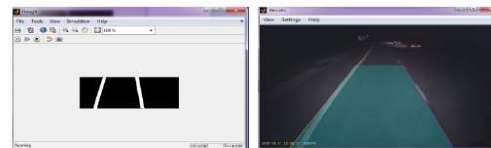
**B. Result of Dark Night Condition**



Result1. RGB Image Result 2.Gray Image Result 3.Resizing



Result4. ROI Result 5.Edge detection Result 6.Hough space



Result 7.Lane detection Result 8.lane tracking

**Figure 6: Output of Lane Detection & Tracking (Dark Night Condition)**

**D. Result of Dawn Condition**



**Figure 8: Output of Lane Detection & Tracking (Dawn Condition)**



E. Result of Rainy Condition

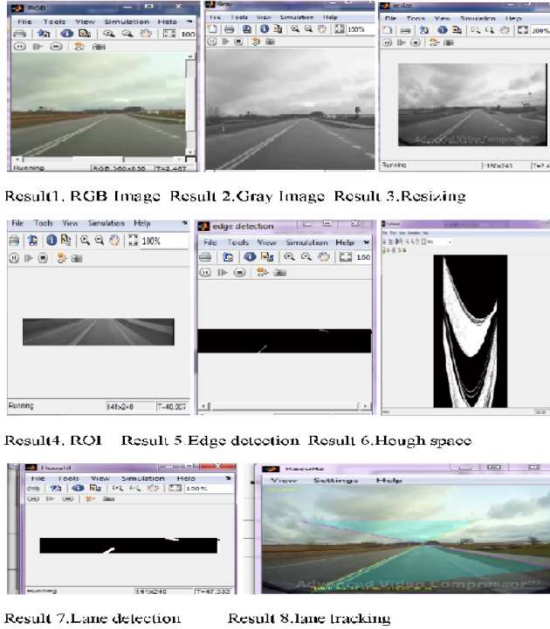


Figure 9: Output of Lane Detection & Tracking (Rainy Condition)

F. Result of Trees Shadow Condition

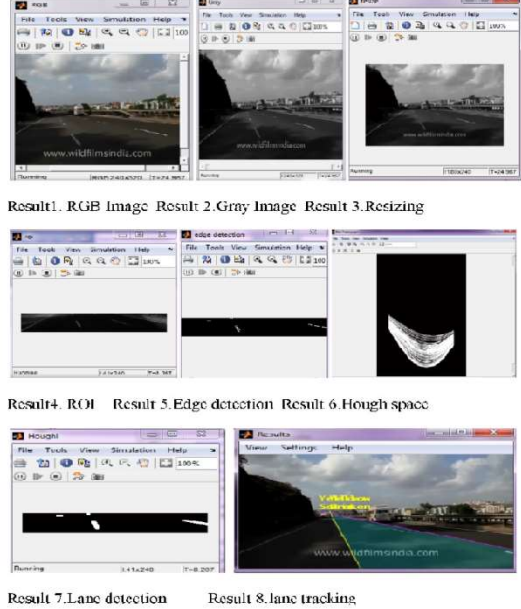


Figure 10: Output of Lane Detection & Tracking (Trees Shadow Condition)

G. Result of Morning Fog Condition

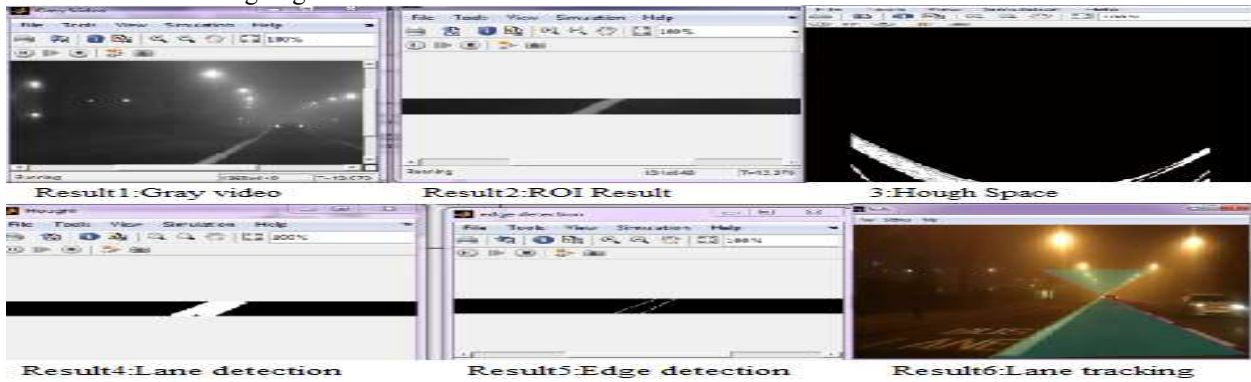


Figure 11: Output of Lane Detection & Tracking (Fog Condition)

Conclusion

By using intelligent system which are applied in RGB to gray image at different conditions based on all the parameters ie Min, max, mean, std. deviation and variance which are easy to detect and to track Lane properly using Hough transform and Kalman Filter in different light, different weather and different road conditions and which are used in LDWS to reduce traffic accidents. Here we are dealing with result of the Lane detection and Lane Tracking on a real time video by using Kalman filter, Hough transform and sobel edge detection technique in modelling type by using the Matlab/Simulink. We are concentrating how the Hough Transform and Kalman Filter works. This Intelligent based technique of detecting and tracking the Lane gives good result. This Hough Transform and kalman filter gives better results in case of any condition. The computations are less complex. This research reported Lane detection and Lane Tracking system of different scenarios like weather, Light and road conditions based on images taken from video camera mounted on the vehicle. In this system, lower parts of the input frames out of the video sequence, image is performed, Edge detection and auto thresholding operation.

### Future Scope

Extended Hough Transform and combined Kalman Filter and particle filter are further used for the detection of lane marks and lane boundaries and Kalman Filter for Lane tracking are proposed using Intelligent systems like Fuzzy. By using machine learning and open Cv to the detected lane and track the lane change the system detects deviation of vehicle from the lane and issues an alarm to warn the driver.

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