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RESEARCH ARTICLE

Improved Detection and Tracking of Lane Marking Using Hough Transform

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Abstract— Autonomous driver assistance system is a core component for the robust detection and tracking of lane markings on roads and pedestrian detection. The lane detection method is a major component of intelligent transport system. Lane detection helps to estimate the road geometry ahead as well as lateral position of vehicle. A fast lane detection algorithm is proposed by Hough transform which is faster as compared with training and testing model based on pixel hierarchy descriptor. The right and left lane markings are marked by different lines. When the vehicle departs from one lane to another, the color of the lane detection system will change accordingly. The proposed algorithm partitions the camera captured image into two parts, lower and higher part and tries to detect the lane separately. The pedestrian detection is done by Histograms of oriented gradients and this system exhibits high accuracy.

Keywords— Lane markings, Hough Transform, 2D filter, Pedestrian detection

I. INTRODUCTION

Emergent interest in intelligent vehicles has been occurring now days. The U.S. Department of Transportation created a prominent initiative on autonomous vehicles, to avoid highway crashes and to take safety measures. Researches are done by the constant intelligent vehicle to transform the way vehicles and drivers interact in the future. Lack of attention of the drivers is the main reasons for accidents. A driver may get diverted by many things like change the Song from the music player, some distractive activities by persons in the vehicle, environmental conditions, etc. are the main reason why the driver gets distracted. There has been a considerable amount of research has been done in the field of vision based road lane detection and tracking. This vision based localization of the lane marking can be separated into two sub problem: lane detection and tracking. Real time road lane detection is the problem of finding the lane boundaries without and information about road geometry and other property. The majority of lane detection techniques are edge based.

Fig. 1.Original image, Process image and Hough Transform image

Subsequent to an edge detection step, the edge based techniques arrange the detected edges into significant structure (lane markings) or fit a lane model to the discovered edges. In the contrast most of the edge based techniques use straight lines to represents the lane boundaries. Pedestrian detection is also important for autonomous vehicle to stop the vehicle.

II. PROPOSED SYSTEM

In image analysis, Hough Transform is used for feature extraction in digital image and computer vision processing. In a parameter space, the voting procedure is done from where object candidates are obtained as local maxima which is called as accumulator space which is clearly constructed by the Hough transform algorithm. We use this Hough Transform for Lane marking and detection in autonomous system. Two Lanes are detected and consecutive frames are taken, and the detected lanes are compared then we get to know whether the lanes are present or not. Pedestrian detection is important for an autonomous vehicle for stopping the vehicle to avoid road accidents.

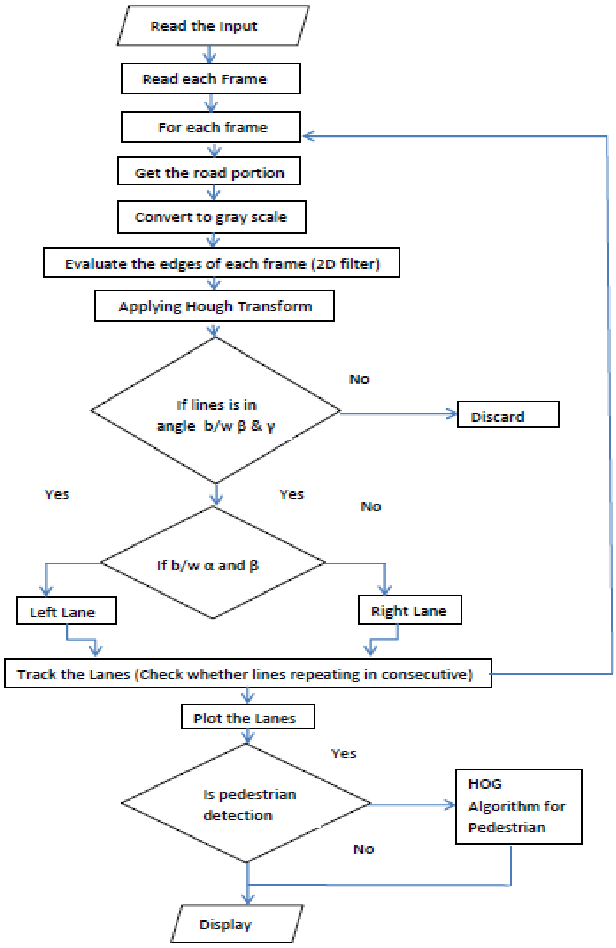

Fig. 2.Flow chart of Overall System

A. System Overview

The lane detection is based on Hough Transform. The pedestrian detection is based on Histogram of Oriented Gradient (HOG) which is the best method of people detector which is implemented here to avoid road accidents. The fig .2 shows the overall system overview. Basically the input video is a road traffic system. The camera is mounted on the moving vehicle and each frame is taken one by one.

For each frame in the video get the road portion, convert to gray scale. The different edge of the image portion which was converted to gray scale is detected using the 2D filter. Then apply Hough transform to vote the largest line. If the line is not between β and γ, then discard. Else check whether if angle between α and β, if yes, left lane and else case it is right lane. We plot the detected lines as lanes and continue tracking. The trajectory is continued as long as the lanes are detected in consecutive frames. Finally the detected lanes are plotted

Fig. 3.Taking the road portion from a frame.

B. Modules

1. Segmentation of Road

The captured image is extracted into parts that the road part and non-road part. The road part consists of the lower image which includes the lanes that are to be detected. Remaining is the upper part of the image excluding the Road.

2. Binarization

The method of converting an image of up to 256 gray levels to a black and white image is so called as Binarization. For this method we have to classify all pixels with values above this particular threshold value as white, and all the other pixels as black. This threshold value is selected.

3. Edge detection

A set of curved line segments termed as edges, are points at which the image brightness changes sharply. As the image brightness changes suddenly, more formally, and discontinuities the identification of the points in digital image is done by the edge detection process. Edge detection is done to find all the possible edges of the image. There are many types of edge detectors gradient and Laplacian filters. Here 2D filter is used to detect the edges

4. Hough transform

Hough transform is used to vote the largest line in an image. The idea of Hough transform is explained in the next section

5. Adjacent frames

The adjacent frames are taken to mark the lanes on the road. If the frames has repeated large lines is identified as lanes

6. Left and Right Lane

The left lane and right lanes are identified separately. The road portion is halved into two parts the right part is coloured with one colour and the left lane is coloured with another colour

7. Line plotting

Next the lines are plotted with the highest count of pixels (Hough peak)

8. Pedestrian Detection

HOG (histograms of oriented gradient) is used for pedestrian detection [3]. Each 64×128 detection window is divided into 8×8 pixel cells and each group of 2×2 cells constitutes a block with a stride step of 8 pixels in both horizontal and vertical directions. Each cell consists of a 9-bin histogram of oriented gradients, whereas each block contains a 36-D concatenated vector of all its cells and normalized to an L2 unit length. A detection window is represented by 7×15 blocks, giving a total of 3780-D feature vector per detection window. The basic idea is that local object appearance and shape can often be characterized rather well by the distribution of local intensity gradients or edge directions, even without precise knowledge of the corresponding gradient or edge positions.

Fig. 4.Converting to gray scale

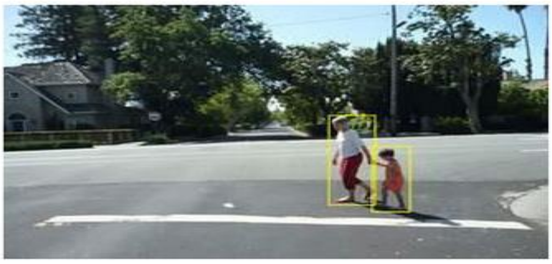

Fig. 5.Detection of Pedestrian using HOG

Basic idea of Hough Transform

The main idea is Hough transform. The Hough transform work on a Hough space in which each point uniquely identifies a line by an angle Φ and perpendicular distance 'w' from the origin. All the points can have infinite number of lines through and all the points in Hough space with an intersection greater than a threshold is identified as a line which can be shown by the basic algorithm.

Hough space

Basically representation of line in the image space as a point in the plane is defined by (w,Φ). This is called Hough space in Hough Transform.

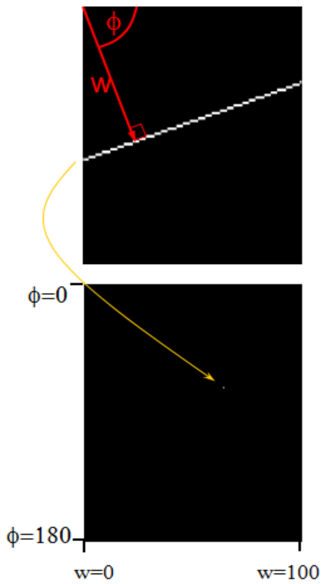

Fig. 6.A line in image space represented as point in Hough space.

C. Algorithm for Hough Transform

For every possible line create ϕ and w

An array A indexed by ϕ and w is created

For each point (x,y)
    For each angle ϕ
        w = x*cos(ϕ)+ y*sin(ϕ)
        A[ϕ,w] = A[ϕ,w]+1
    End
End
Where, Threshold = h
A > h,
Return a line

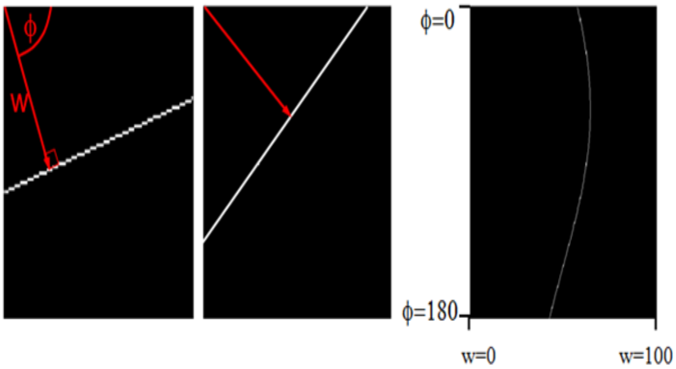

Fig. 7. Point voting in image space.

Fig. 8.Detection of lane markings using Improved Hough Transform

III. IMPLEMENTATION DETAILS

The video is taken and each frame is taken, the Lower portion is changed to gray scale and edge is detected using 2D filter. The largest lines are detected using Hough transform. Then possible lanes are filtered out from the detected lines. In order to reduce false positives such as pavements and zebra crossings we check whether the lines repeating in consecutive frames, then continue tracking else apply Hough transform to find new lines. The repository value is compared with the value in the present frame and if the present frame has the largest value the count is increased.

A. Algorithm for detection and tracking of frames

Input: The video
Output: The tracked video

Step1. Start
Step2. Read the video.
Step3. Read each frames one by one.
Step4. Take the lower portion (road portion) of each frame.
    4.1 Convert to gray scale.
    4.2 Find the edges in the gray scale image using 2D Filter

4.3 Detect all possible lines in the edge map using Hough Transform.

Step5. Filter out the possible lanes from the detected lines.

Step6. Reduction of false positives

6.1 Track the selected positive lines in the consecutive frames.

6.2 Check whether the lines are repeating in the consecutive frames.

Step7. End

IV. EXPERIMENTAL RESULTS

The proposed lane marking technique has been evaluated and compared with an existing lane detection method in the same scenario. The objective is to evaluate the execution time using the proposed technique with respect to the number of frames and seconds. All the experiments were conducted on an Intel Core 2.40 GHz PC with 6 GB of memory. All the algorithms were implemented using MATLAB.

A. Analysing Computation Time by Hough transform

In order to check if the proposed method is able to reduce the overall computation time caused by Hough transform method. Here, time required for the method to track and detect lanes by training and testing of frames takes huge amount of time. Figure 9 shows how much the execution time is reduced using the proposed method as compared to the existing lane detection method. In this figure, time required for solving Hough transform is represented by running the video.

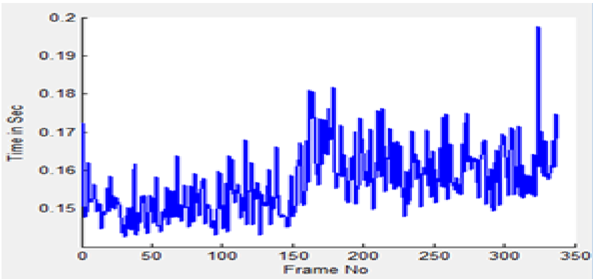

Fig. 9.Time taken for each frame.

V. CONCLUSION

Lane detection is important because it is an integral part of autonomous vehicle control system. Lane detection and pedestrian tracking system using Hough transform and Histogram of gradients respectively is proposed. The system is much faster in terms of execution time compared to the existing approaches.

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