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PEDESTRIAN AND LANE DETECTION SYSTEM

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ABSTRACT

Pedestrian and Lane detection system is an AI based system that will help in enhancing the on road security aspects, and also making the intelligent system to classify the environment to make autonomous vehicle. The main objective of this project is to create the intelligent model to automate the vehicle and improve the security of pedestrian as due to increase in vehicle count there is also an increase in count of casualties occurs due to road accidents, this machine learning algorithm used to build the Pedestrian and lane detection system will enhance the AI features to interact according to the environment on the basis of dataset provided.

Keywords: Artificial Intelligence, Machine Learning, Deep Learning, Hough Transform, Canny Edge, HOG Descriptor, SVM, Region Of Interest.

I. INTRODUCTION

The pedestrian and lane detection system is the AI based program that will help upcoming generation by assisting in safe driving. This is possible due to machine learning based algorithms being effective day by day with the growth of global automobile industries it has become biggest industries in the world and the difficulties of road and lane perception is the crucial enabler for advanced driver assistant system a study by World health organization road accidents are ninth leading cause of deaths in india.in the country where accidents happen each minute and life is lost each four minutes according to the survey 30% of drivers who used mobile phones during driving had accidents and currently according to the survey modeled the effects of mobile phones and it has been seen a distracted drivers belonging to different age groups in India. There are different kind of distractions happens because of distracted drivers i.e. Visual- where taking eyes off the road, Manual- taking the hands off the wheels, Cognitive- taking mind off driving. To have control over the vehicle, there is need to develop the autonomous system that can detect the road lane and move accordingly.

There are also casualties seen of pedestrian crossing the road in busy road, to avoid this kind of casualties there is also need to develop the autonomous system that can also detect the pedestrians that instantly appears on road. The pedestrian detection system can be achieved by using supervised learning methods in machine learning. There are techniques that can achieve this learning method that is using HOG Descriptor (Histogram of Oriented Gradients).

Histogram of oriented gradients is the most popular method to detect the humans from the picture. SVM classifier is used to classify the background image and human.

To detect the lane of the road so that the vehicle can track the lane and move in the particular lane, due to instant change in the lane without noticing the another vehicle around can lead to accident, to avoid this the lane detection system is to initiated in the vehicles. This can be achieved by using the machine learning algorithms that can classify the lane and the background around the frame. The different algorithms to achieve detection are finding the region of interest, applying Hough transform, applying Canny Edge. Applying this kind of algorithm can lead to detect the lane in the video frame.

II. METHODOLOGY

The proposed work collects the data from the video feed and separate them into different frames. For each and every frame the background can be subtracted from the foreground of the particular frame and compares the foreground for every frame. HOG method is useful to create the histogram and its magnitude or the orientation of objects in the frame. The extracted foreground objects are then classified using the classification method i.e. SVM (Support Vector Machine), which uses the supervised learning algorithm used for classification and regression.

In detecting the pedestrian the most useful method for object identification is HOG (Histogram of Oriented Gradients), using this method the shape of the objects are determined without smoothing of the image. Then

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after Gradient and magnitude or Orientation is calculated. HOG algorithm was used to detect the pedestrian but to detect the lane for vehicle we need different algorithms.

In detecting the lane the first requirement is to find the region of interest or define the region of interest in the frame. Where the region of interest are the vertices over the frame where it define the area that needs to be estimated and that foreground is then used for further process of detecting lane. After defining the region of interest next step is to detect the edges in the frame because edges are the area of the image where the color values changes very quickly, so to detect the lane the need is to crop the image into the edges. After getting the edges in the frame then we can apply the algorithm to detect the lane – Canny Edge detection ,where the canny edge detector is an edge detection operator that uses multistage algorithm to detect the wide range of edges in an image. After applying the canny edge there is one part remaining to detect the lane where the short lanes exist, the short lane in mid- road are at some instant, to create the imaginary line passing through or connecting all the edge point of the lane are connected and the lane is generated using Hough Transform.

Pedestrian Detection

To detect the pedestrian or the objects in the frame can be achieved by HOG Descriptor. Histogram of Oriented Gradients, is a feature descriptor that is used for extracting features from image data. It is widely used in computer vision tasks for object detection.

This algorithm checks directly surrounding pixels of every single pixel. The goal is to check how darker is the current pixel compared to the surrounding pixels. The algorithm draws and arrows showing the direction of the image getting darker. It repeats the process for every pixel in the image. At last, every pixel would be replaced by an arrow, these arrows are called Gradients. These gradients show the flow of light from light to dark. By using these gradients algorithms perform further analysis.

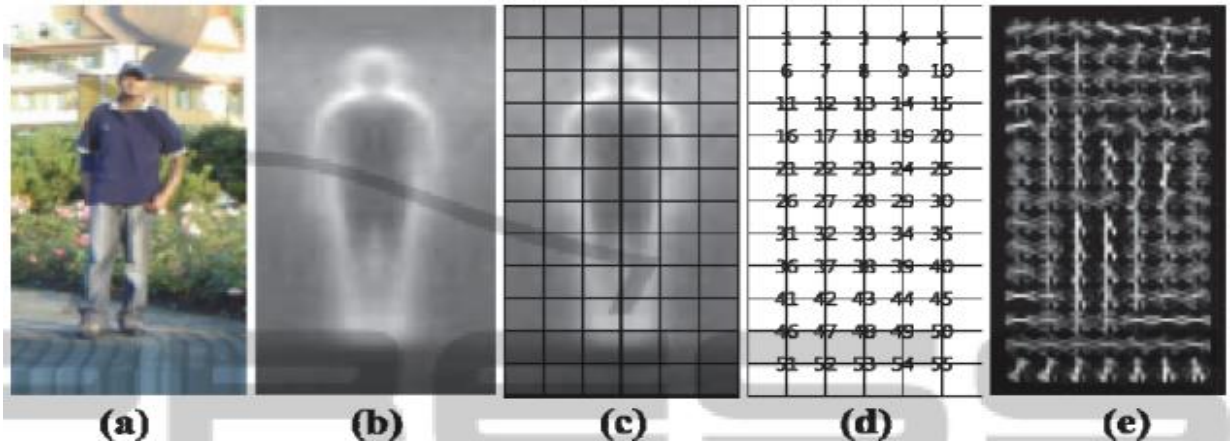

Figure 1: HOG descriptor

HOG algorithm involves algorithm steps to perform-

1. Preprocessing of data :- In preprocessing of data we need to preprocess the image and bring down the width to height ratio to 1:2. The image size should preferably be 64 x 128. This is because we will be dividing the image into 8*8 and 16*16 patches to extract the features. Having the specified size (64 x 128) will make all our calculations pretty simple.

2. Calculating the Gradient (Direction of x and y):- The next step is to calculate the gradient for every pixel in the image. Gradients are the small change in the x and y directions. Hence the resultant gradients in the x and y direction for this pixel can be calculated as :

- Change in X direction(Gx) = x2 – x1
- Change in Y direction(Gy) = y2 – y1

3. Calculating magnitude or Orientation :- we saw how to calculate gradients in the last step, we will now determine the magnitude and direction for each pixel value. For this step, we will be using the Pythagoras theorem.

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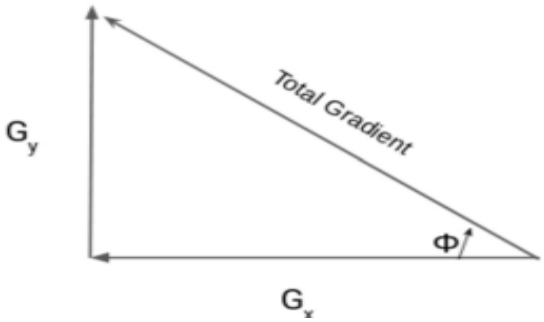

Figure 2: magnitude and orientation

Total gradient magnitude can be calculated by –

$$\text{Magnitude} = \sqrt{(Gx)^2 + (Gy)^2}$$

Orientation or the direction can be calculated as –

$$\text{Tan}(\alpha) = Gy / Gx$$

4. Feature for complete image: - After calculating the gradient , magnitude and the orientation of the image the next step is to normalize the matrix vectors of the image and will get the featured image.

Lane Detection

On the Highways road on which the lanes of white lines are visible to the Humans is obvious. We perform processing of this image intuitively, and after being trained it can detect the lane in which the vehicle appears to be moving.

To build the model to detect the lane on the road the supervised learning algorithms are used to build the model like

Canny Edge Detection, Hough Transform, can be used to classify and detect the road.

The algorithmic steps involve –

1. Defining the region of interest:- region of interest is the area in the frame in which the required foreground image is considered so that only that part of area can be calculated further. To achieve the region of interest in detecting lane only the shape that can achieve is triangle that begins at the bottom left corner of the image, proceeds to the center of the image at the horizon, and then follows another edge to the bottom right corner of the image.

The vertices are bottom-left corner, center of the image at horizon, and another at bottom right corner, to do so we will use following calculation:

$$\text{Region\_of\_interest\_vertices} = [\ (0, \text{height}), (\text{width} / 2, \text{height} / 2), (\text{width}, \text{height})\ ]$$

After getting the region of interest we will crop the image as per the requirement generated by calculating region of interest vertices, and it looks as shown in below Figure 3

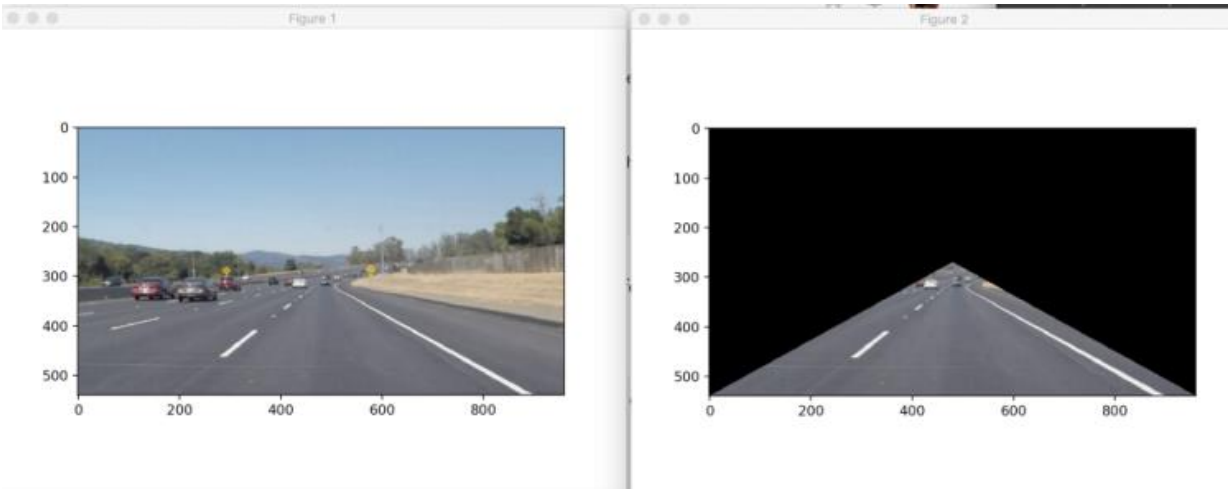

Figure 3: Defining region of interest

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2. Canny Edge detection:- The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. The Canny edge detection algorithm is composed of 5 steps:

- Noise reduction.
- Gradient calculation.
- Non-maximum suppression.
- Double threshold.
- Edge Tracking by Hysteresis.

Noise reduction can be done by using Gaussian blur to smooth the image. To do so, image convolution technique is applied with a Gaussian Kernel. The Gradient calculation step detects the edge intensity and direction by calculating the gradient of the image. Edges correspond to a change of pixels' intensity. To detect it, the easiest way is to apply filters that highlight this intensity change in both directions: horizontal (x) and vertical (y).

Ideally, the final image should have thin edges. Thus, we must perform non-maximum suppression to thin out the edges. The principle is simple: the algorithm goes through all the points on the gradient intensity matrix and finds the pixels with the maximum value in the edge directions.

The double threshold step aims at identifying 3 kinds of pixels: strong, weak, and non-relevant: Strong pixels are pixels that have high intensity that we are sure they contribute to the final edge. Weak pixels are pixels that have an intensity value that is not enough to be considered as strong ones, but yet not small enough to be considered as non-relevant for the edge detection. Other pixels are considered as non-relevant for the edge. High threshold is used to identify the strong pixels (intensity higher than the high threshold) Low threshold is used to identify the non-relevant pixels (intensity lower than the low threshold) All pixels having intensity between both thresholds are flagged as weak and the Hysteresis mechanism will help us identify the ones that could be considered as strong and the ones that are considered as non-relevant. Based on the threshold results, the hysteresis consists of transforming weak pixels into strong ones, if and only if at least one of the pixels around the one being processed is a strong one.

3. Hough Transform:- After getting the Edges from the image, after getting the edges the next thing is to generate the lines from edges. Human can easily recognize the line looking through the edges but the computer does not understand. Using a Hough Transform, we will transform all of our edge pixels into a different mathematical form. Once the transformation is complete, each edge pixel in "Image Space" will have become a line or curve in "Hough Space". In Hough Space, each line Space, and each point represents a line from Image Space. To calculate Hough transform For the Hough Transform algorithm, it is crucial to perform edge detection first to produce an edge image which will then be used as input into the algorithm. If there are two edges, we suppose to find the line passing through the both the edges represents a point from Image.

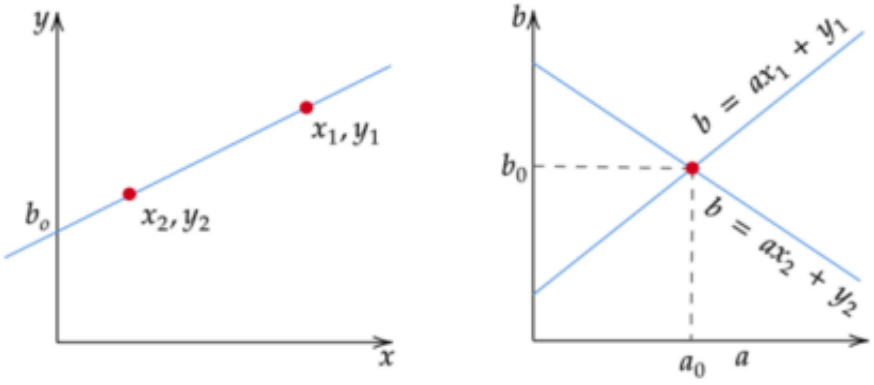

Figure 4: Edge points to Hough Space

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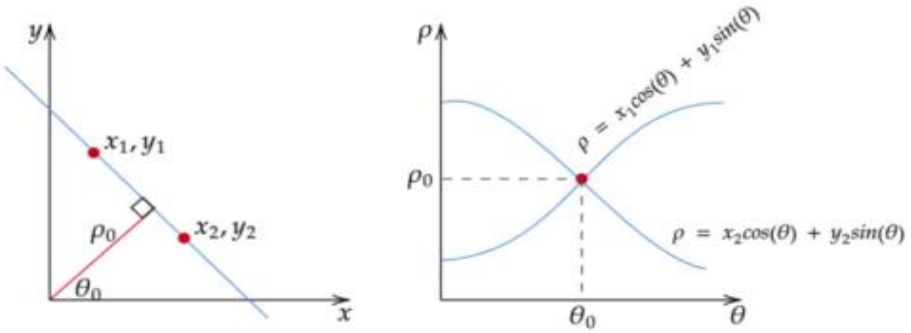

Figure 5: An alternative representation of a straight line and its corresponding Hough Space

III. MODELING AND ANALYSIS

The basic model for the pedestrian detection system consist of – input of video feed, frames of images, Background subtraction from fore ground, HOG descriptor, SVM classifier, and last release the result as a classified image with feature extraction. The basic model is shown in below figure –

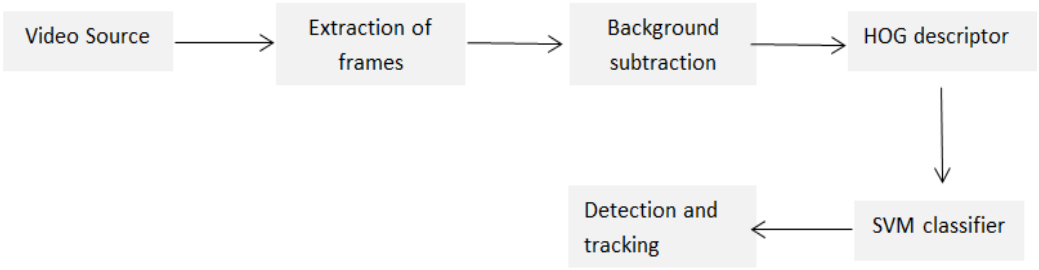

Figure 6: Model for Pedestrian detection

The Model for detecting lane consist of Preprocessing of the image, Edge and segment detection from the area of interest , Canny edge and Hough Transform and final outcome of hypothesis of right and left lane.

The structure of Lane detection system –

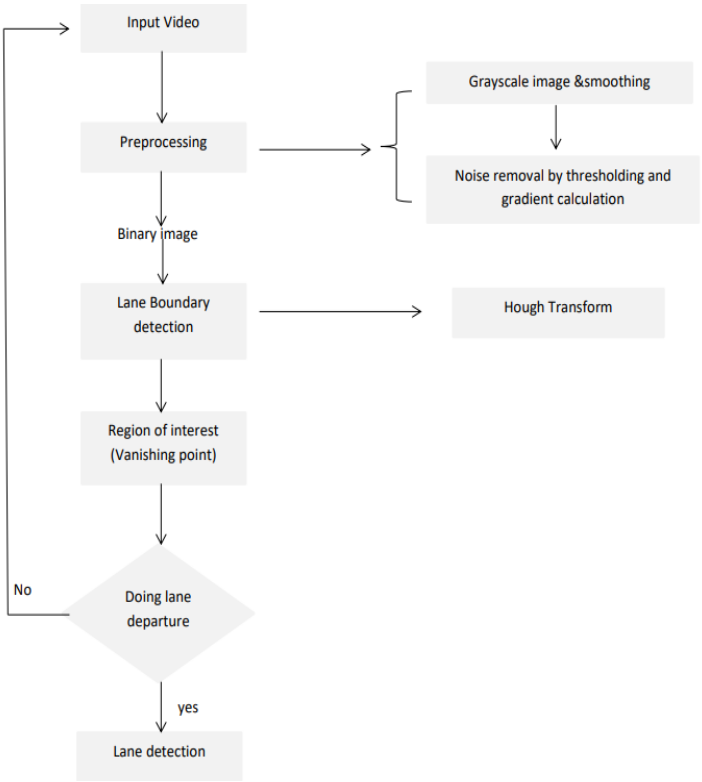

Figure 7: Structure of Lane detection system.

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The model of Lane detection system is –

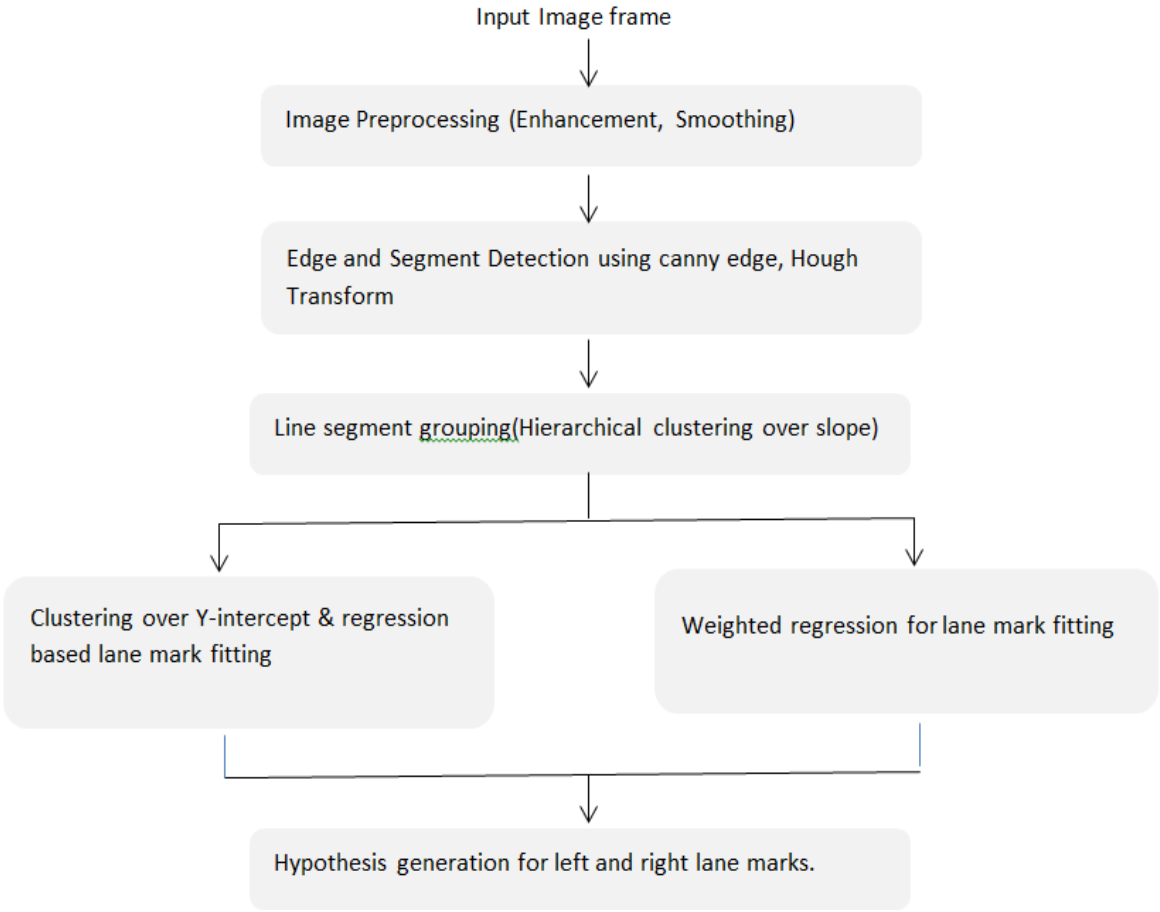

Figure 8: Lane detection system model.

IV. RESULTS AND DISCUSSION

As per the output generated by the code in python where the above algorithms are used to build the model, and has given approximately around 70% to 80% of accuracy rate but if provided with more datasets can improve the model. The following are the results –

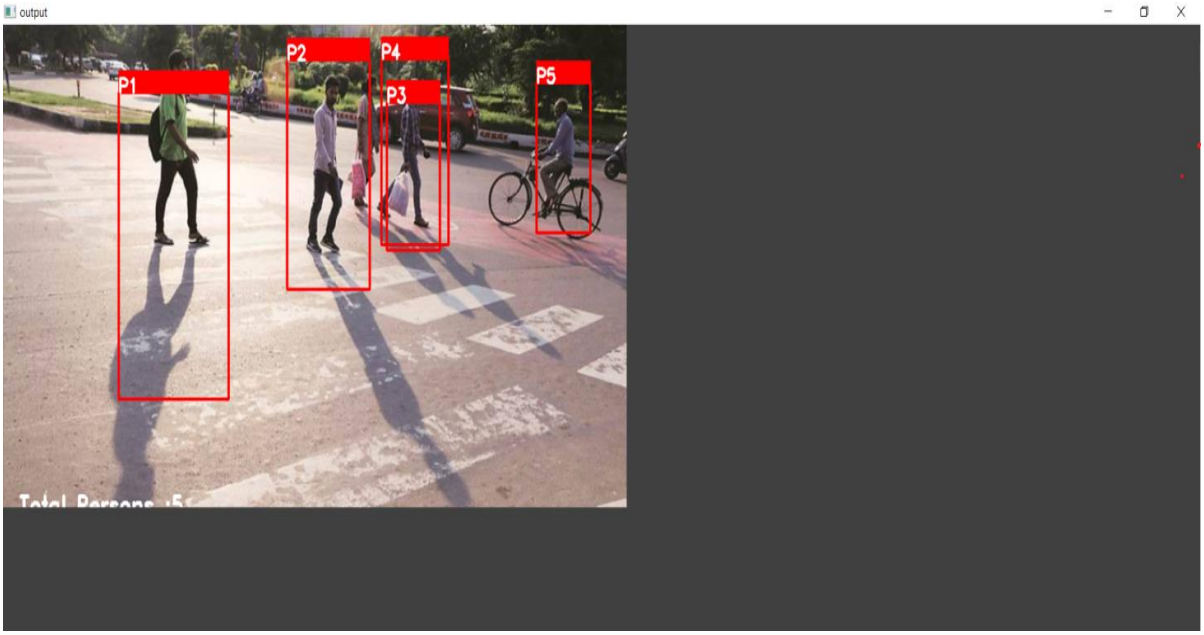

Figure 9: Result generated for pedestrian detection.

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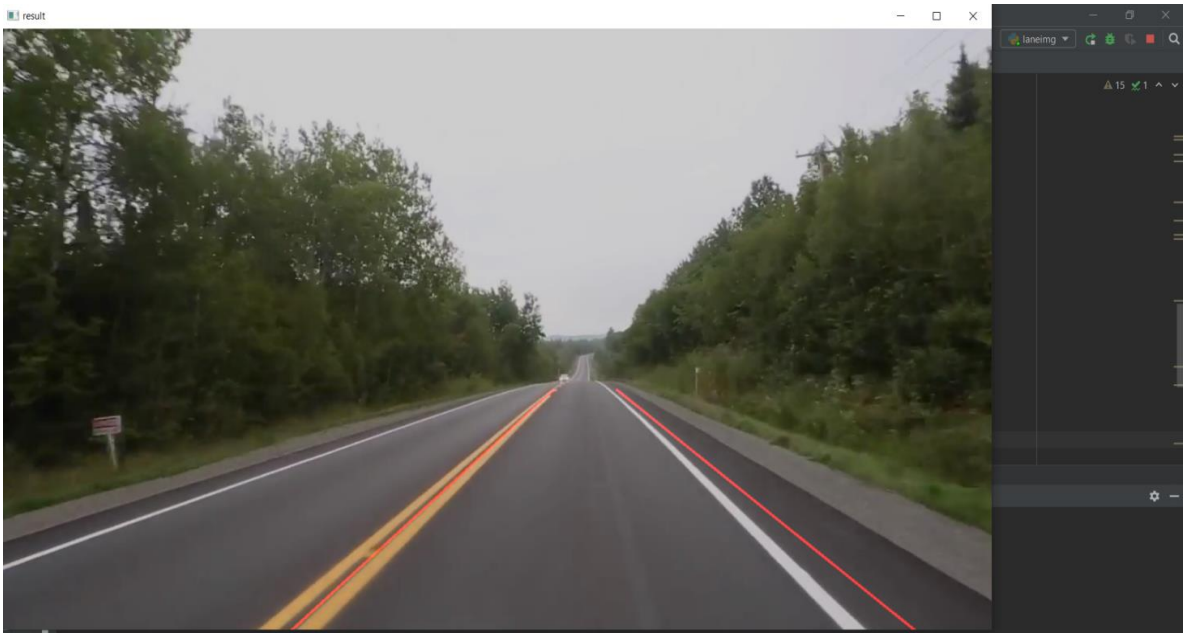

Figure 10: Result for Lane detection

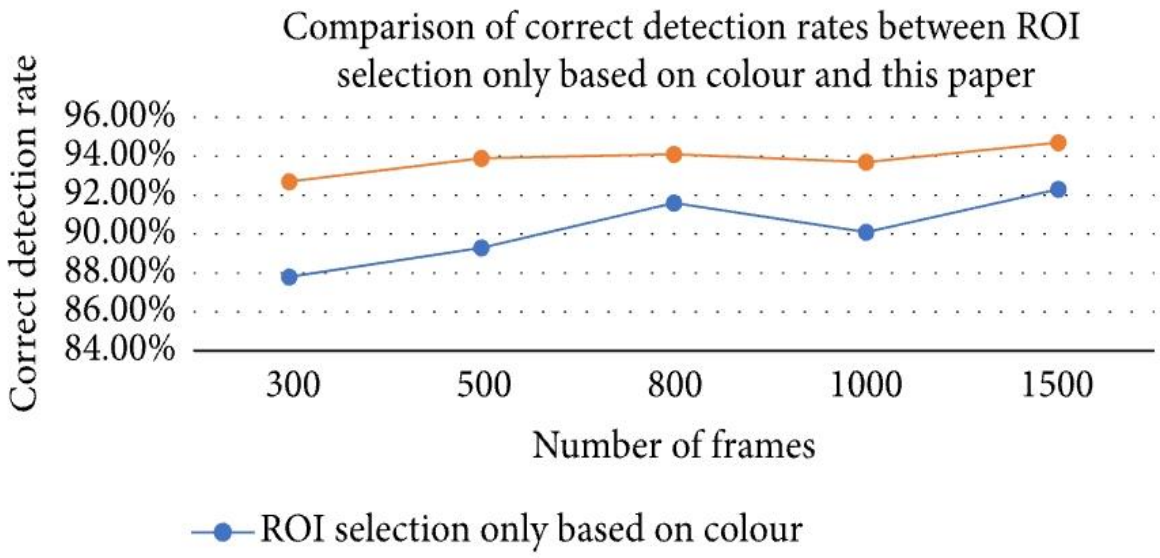

Figure 11: Accuracy rate

V. CONCLUSION

Pedestrian detection and Lane detection system as a hot spot in intelligent transportation systems has a great social significance. In this paper, the HOG feature vector is used as a descriptor for detecting and Hough Transform for finding the point or the line to detect the lane and train the model. It can avoid the influence of the test results caused by exposure, shadows, background and camera angle variation. Simple and practical SVM is chosen as classifier so that it ensures the accuracy of the results and the rapidity of judgments. It can be seen from the experimental results that combined HOG feature and SVM algorithm has obtained better detection results for pedestrian detection ahead of vehicle in single frame video image, and using Hough Transform method finding the lane.

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