On-Road Object Detection using Computer Vision Techniques for Advanced Driver Assistance Systems (ADAS)

Sai Sravan Manne
Roll No. EDM13B018

Guided By:
Dr. Binsu J Kailath

OBJECTIVE

- Understanding the current
  - on-road object detection techniques
- Developing the initial design
  - in MATLAB, and
  - later implementation using Python
  - with a major focus on optimizing its performance on GPU

INTRODUCTION

- Autonomous Driver Assistance Systems:
  - automate/adapt/enhance vehicle systems
  - for safety and better driving
- Autopilot system:
  - disruptive technology in coming decade
- Several algorithms proposed in the past
  - based on edge/pattern/texture recognition
  - to identify on road objects
- In 2012 a new CNN
  - deep learning based algorithm
  - demonstrated highest level of accuracy
  - very minimum computation time
- However, requires high end GPU
  - increase in system cost
- ADAS need reaction time less than 30ms

METHODOLOGY

- Following are a few techniques that are developed in recent years

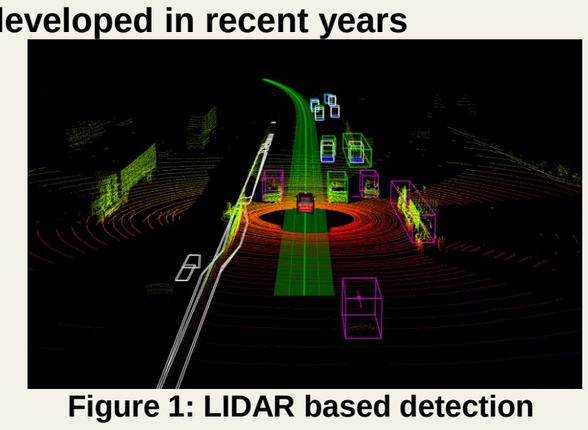

Figure 1: LIDAR based detection

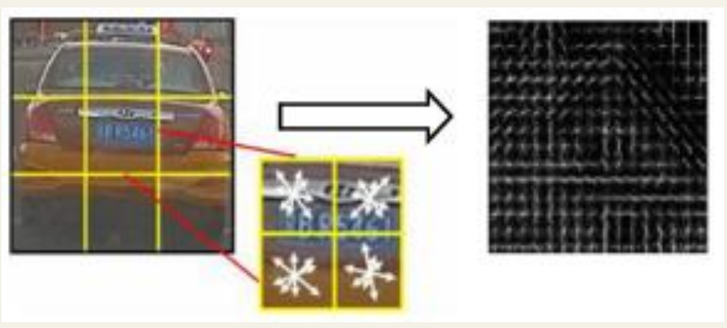

Figure 2: Histogram of oriented gradients(HOG) based feature extraction

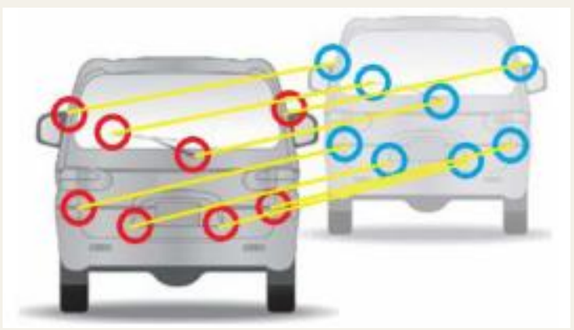

Figure 3: Tracking based on feature point matching

- In general, neural network and LIDAR based solutions:
  - complex
  - requiring high end GPU,
  - for higher frame rates
- Feature extraction based solutions require
  - image classifiers to eliminate false detections

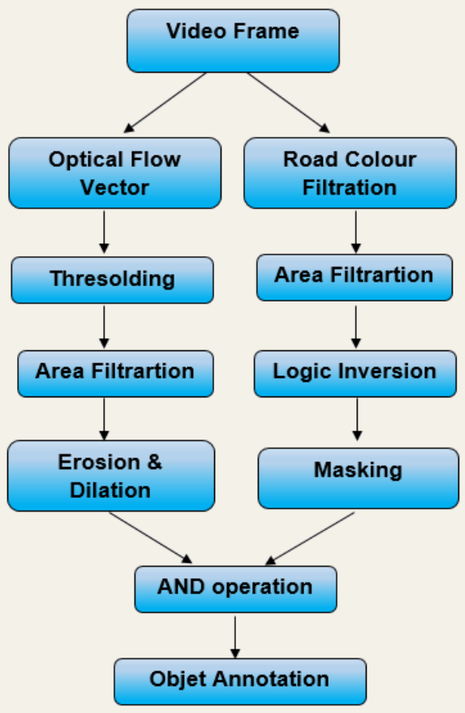

Figure 4 (Previous Algorithm)

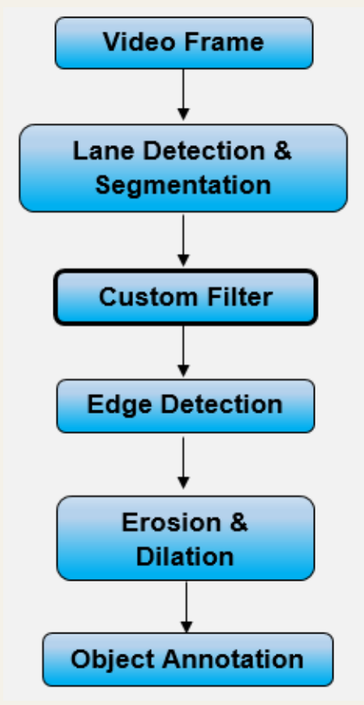

Figure 5 (Modified Algorithm)

- Lane detection used to crop out unnecessary area
- Custom filter smoothens
  - broken white lane line markings
  - illumination variations

RESULTS & DISCUSSION

- Various stages of the Python function in sequential order

Figure 6: Input Video Frame

Figure 7: Truncated, grayscale output

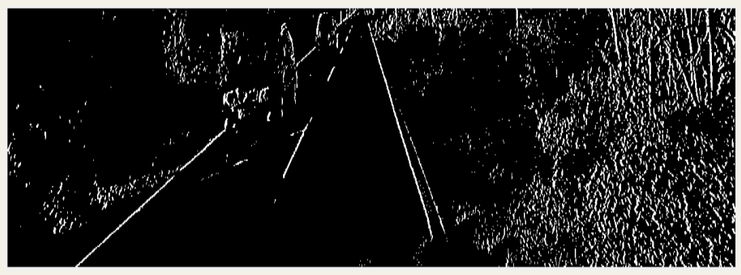

Figure 8: Edge detection and threshold operation

Figure 9: Solid white lane line detection output

Figure 10: Road separation from surroundings

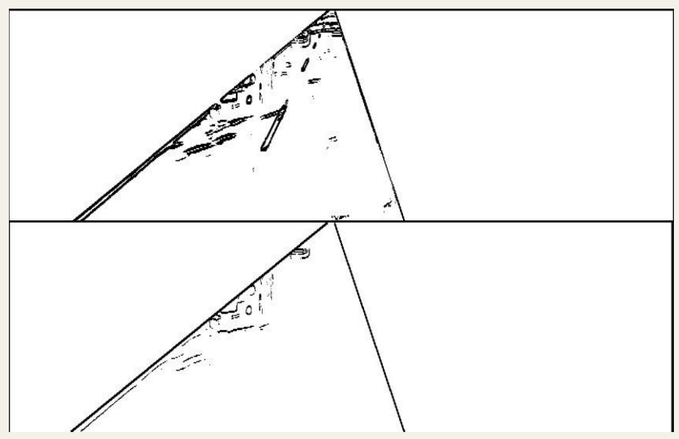

Figure 11: Custom designed filter output comparison

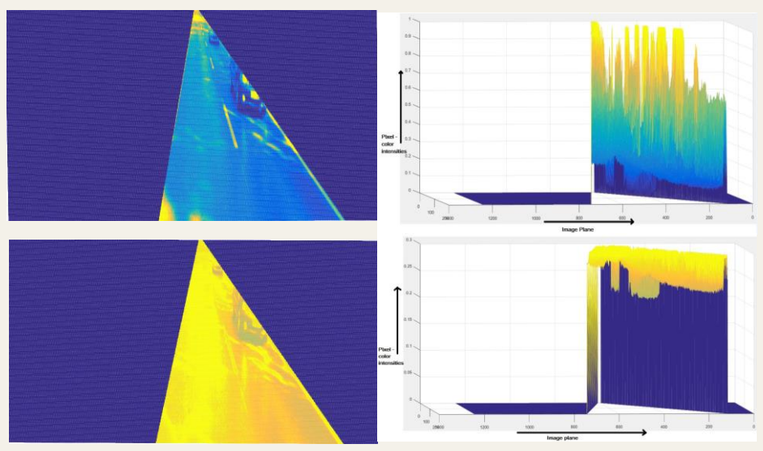

Figure 12: Reduced color intensity variation

Figure 13: Final output

- System specification: windows workstation, Intel-i5, 8GB RAM, 3.2GHz

	FPS	Image Size
Proposed algorithm	38~40	[195,640]
[1],2016	36~38	[640,140]
[2],2016	10~13	LIDAR
[3],2016	24	[300,400]

APPLICATIONS

- This system can reduce
  - usage of high-end GPU in autopilot systems in automobiles
  - overall cost of system, to enhance autonomous vehicles in India

REFERENCES

[1] Zhipeng Di; Dongzhi He, " Forward Collision Warning system based on vehicle detection and tracking," *IEEE International Conference on Optoelectronics and Image Processing (ICOIP)* 2016, Pages: 10 – 14.

[2] Phanindra Amaradi etal, "Lane following and obstacle detection techniques in autonomous driving vehicles," *IEEE International Conference on Electro Information Technology (EIT)* 2016, Pages: 0674 - 0679.

[3] Jyun-Min Dai etal, "A driving assistance system with vision based vehicle detection techniques," *IEEE Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA)* 2016, Pages: 1 - 9.