Object Classification using Convolutional Neural Network (CNN) for Advanced Driver Assistance Systems (ADAS)

Sai Sravan Manne
Roll No. EDM13B018

Guided By:
Dr. Binsu J Kailath

OBJECTIVE

- To develop an indigenous system
  - to detect and classify on road objects
  - minimal usage of GPU
- To design, develop and train a CNN
  - incorporating recent advancements in cost
  - back propagation algorithm

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 [1]
  - deep learning based algorithm
  - demonstrated highest level of accuracy
  - very minimum computation time
- Very much suitable for ADAS
- ADAS need reaction time less than few ms
- To avoid accidents

METHODOLOGY

- Data to be collected from Camera / LIDAR

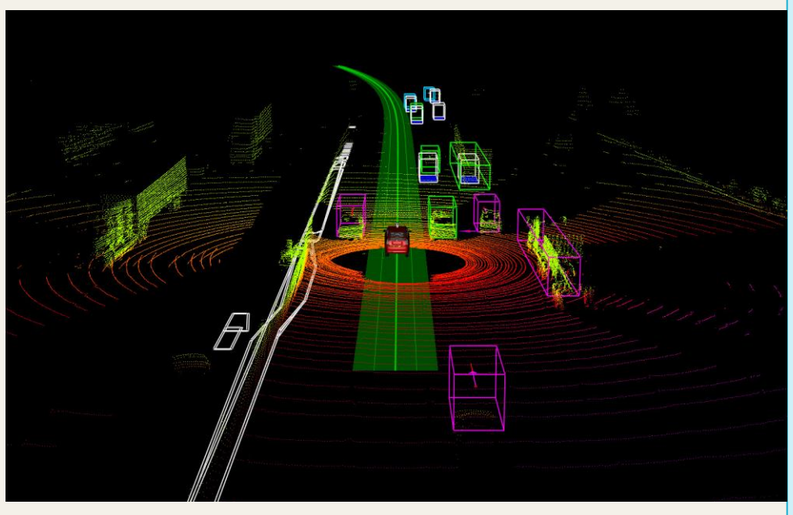
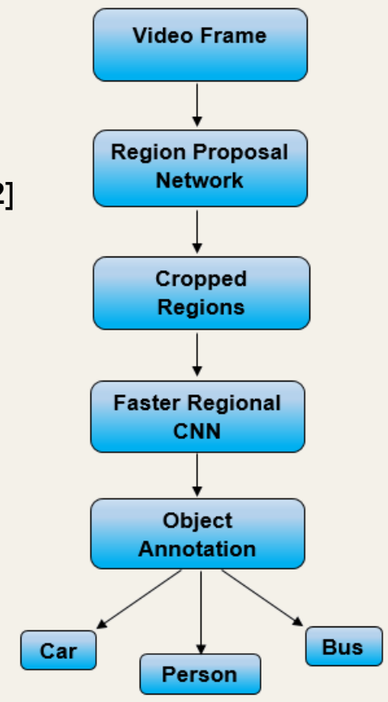


Figure 1. Output from a LIDAR

Figure 2. Output from a camera

- LIDAR provides
  - depth information
  - simply identification of on road objects
- Camera provides
  - 2-D matrix consisting of colour densities
  - Images need to be filtered, very complex
- So as to identify the moving objects
  - camera is being used in real-time system to reduce the overall cost
  - to make the autopilot system affordable
- Methodology implemented in [2],
- Has increased accuracy compared to several CNN's

Figure 3 [2]



- two neural networks are used
  - demands higher GPU.

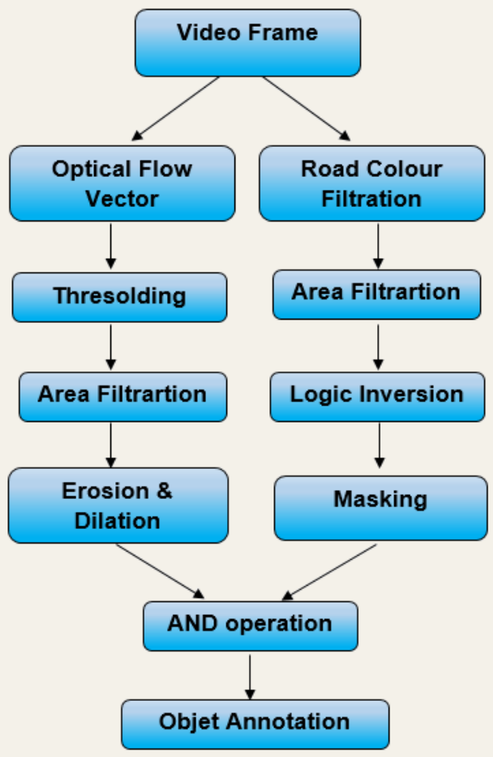


Figure 4 (Proposed Algorithm)

- A specific function in Matlab is used instead of region proposal network

RESULTS & DISCUSSION

- various stages of the Matlab function in sequential order.

Figure 5. Input Video Frame

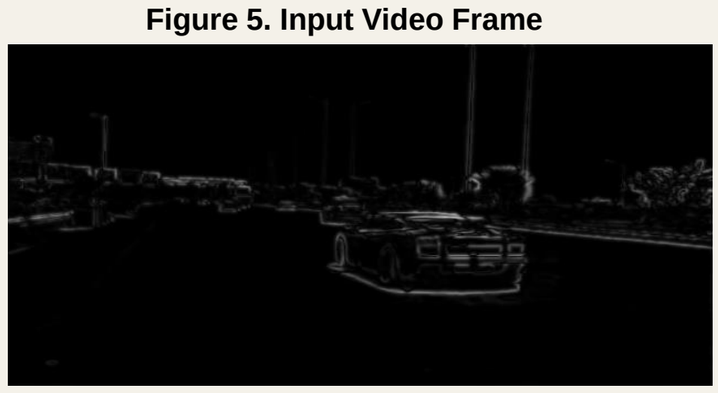


Figure 6. Optical Flow Vector Output

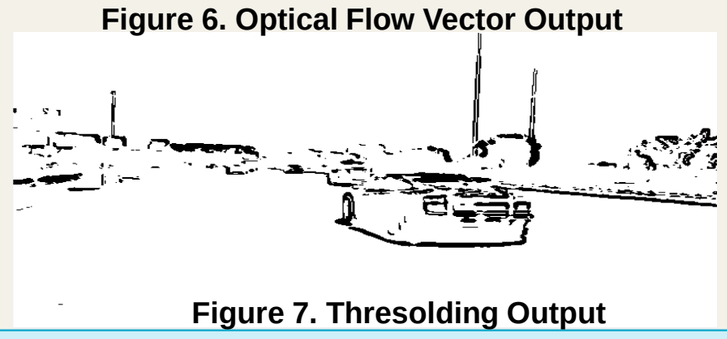


Figure 7. Thresolding Output

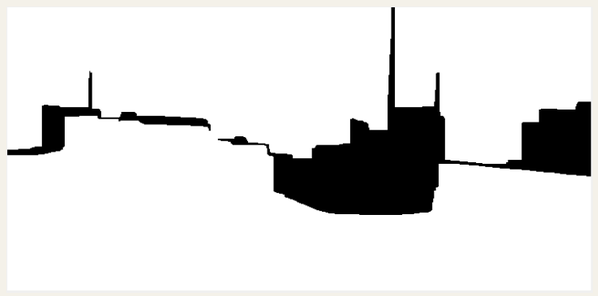


Figure 8. Area Filtration, Erosion & Dilation Output

Figure 9. Road Colour Filtration Output

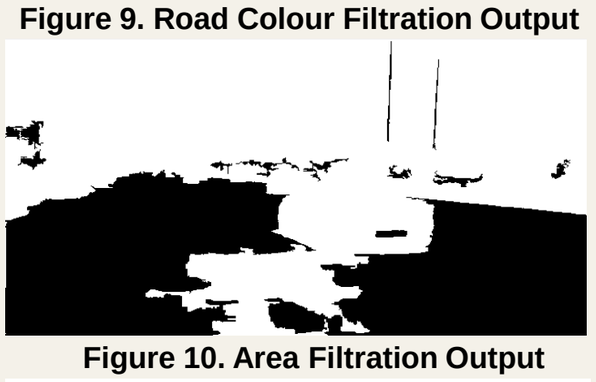


Figure 10. Area Filtration Output

Figure 11. Logic Inversion & Masking Output

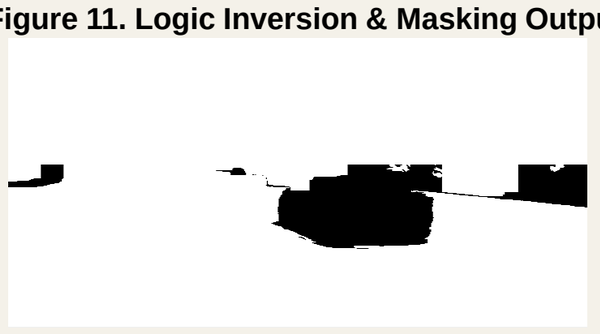


Figure 12. AND Operation of figure11 & 8

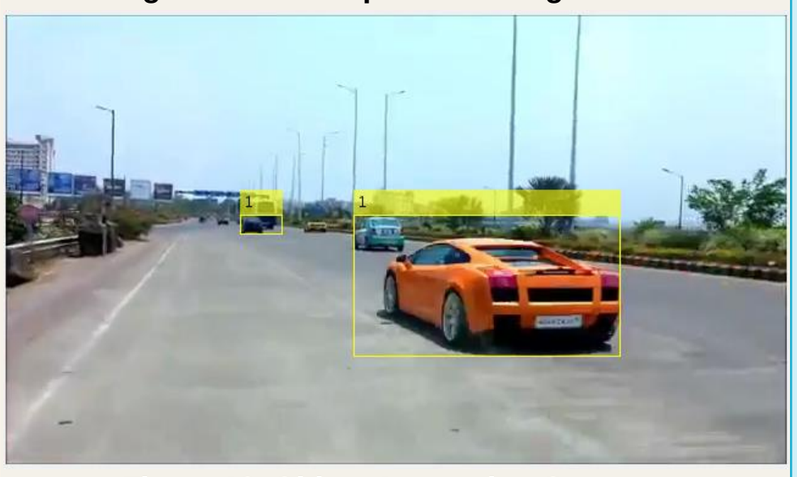


Figure 13. Object Annotation Output

- Proposed algorithm produces region proposals at a rate of 10 fps on a 2GB, 1.2GHz GPU
- Region Proposal Network could process only 2~3 fps on same system

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] AlexKrizhevsky, IlyaSutskever and GeoffreyE.Hinton, " Image Net Classification with Deep Convolutional Neural Networks," Advances Neural Information Processing Systems 25 (NIPS 2012).

[2] Shaoqing Ren, Kaiming He, Ross Girshick and Jian Sunar, " Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks," arXiv: 1506.01497v2 [cs.CV], 13 Sep 2015.