

# **Efficient Vehicle Navigation Agent using Canny Edge and Convolutional Neural Network.**

**PROJECT SYNOPSIS**

**BACHELOR OF ENGINEERING  
Computer Engineering**

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## **1 Title**

Efficient Vehicle Navigation Agent using Canny Edge and Convolutional Neural Network.

## **2 Domain**

Computer Vision and Deep Learning

## **3 Keywords**

Computer Vision, Camera calibration, Object detection, Object recognition, Supervised learning by classification, Deep Learning, Neural networks, Cognitive robotics, Multi-agent systems, Intelligent agents, Mobile agents.

## **4 Team**

Group Id: 1

Team Members:

1. Ameya Kale - 41226.
2. Paritosh Medhekar-41241.
3. Soubhik Das-41208.
4. Yash Gugale-41219.

## **5 Objective**

1. Implementing an intelligent agent capable of receiving percepts from dynamic environment using action camera and taking decision based on computations on captured video feed.
2. Detecting lane lines using Canny Edge and marking them using Hough Transform.
3. Training the classifier using Tensorflow to detect traffic signs.
4. Training the Haar-cascade classifier to detect passer-by vehicles and pedestrians.
5. To compare the performance and the overhead of various techniques and suggest the best solution.

## **6 Scope**

1. Intelligent agent will detect the road lanes using OpenCV image analysis techniques to identify lines, including Hough transforms and Canny edge detection.
2. Intelligent agent will use convolutional neural network to classify traffic signs .

3. Also, it will detect the passer-by cars using Haar Cascade algorithm and other techniques.
4. The detected lane lines will assist the agent to orient the vehicle. By detecting the traffic signs and passer-by the vehicle agent will manipulate driving actions to avoid collision with other vehicles and pedestrians.

## 7 Feasibility Study

### 1. Technical Feasibility

- (a) For detection and marking of lane lines Canny Edge algorithm yielded the best results as compared with Sobel and Robert's edge detection algorithms. Canny Edge algorithm accounts for regions in an image. Algorithm yields thin lines for its edges by using non-maximal suppression. Sobel and Robert's operator produced inaccurate outputs and they are sensitive to noise. Hence we are using Canny Edge algorithm for lane detection.
- (b) The technique of Vehicle detection is by calculating the HOG and then finding the SVC. Finally we use a sliding window to draw a rectangle around the car. This method is better than SSD, as SSD cannot create a heat map. This heat map gives better estimation for the position of the vehicles. Also, SSD gives a marginal error when used with Lane Detection.  
Further, we want to try out how to display the vehicles tracked into a separate frame for easy reference which is an advanced part of vehicle detection and SSD does not support it. So we will first go with HOG, SVC method to get the results.
- (c) In traffic sign detection module, we would compare the model performances using various types of data such as original and standardized data. Further, we would be building traffic sign classifiers. Post classifiers, we would be using it to recognize and predict new traffic signs. Some of the libraries used in our module are pandas, pickle, numpy, matplotlib, keras, etc. The basic part of the module would involve those arithmetic libraries and for advanced detection, keras would be used. We would be doing that using neural networks. Our software engineering approach would be incremental approach.

### 2. Operational feasibility

Here, it is checked if the proposed system is suitable to 3 types of aspects: human, organizational and political aspects.

- (a) It finds whether there is any direct or indirect resistance from the user of this system. Our project is such that the user will have least resistance as just we are developing driverless vehicles. Surrounding system remains the same.
- (b) It finds whether the operations of proposed system is easy or not compared to the existing system. In vehicle navigation, as the vehicles are autonomous, definitely there is a reduction in efforts from the human side. If the drive is long, it becomes strenuous for the driver but in our project, it becomes simple.
- (c) To check whether the user or customer requires extra training. After developing the project as said above, human efforts are reduced to a great extent. In that way, no extra training is required from human side, rather driver's hard work is reduced.

- (d) It finds if any job reconstruction is required or not No job reconstruction is required as no new tasks is introduced. Here, existing tasks are reduced by intelligent agents.
- (e) System provides accurate as well as right info to user at the right place and right time  
The system provides accurate information in a way that the user is informed regarding the lanes and traffic signs. Also, the user in the vehicle reaches his/her destination.

### 3. Ethical feasibility

The various factors which judge whether it is ethically feasible are:

- (a) Legally acceptable Google had built it's self-driving car which won the Stanley DARPA car challenge in 2005. The project was headed by Dr. Sebastian Thrun. So, it's clear that self-driving cars are legal in USA. They are legal in India too. The ultimate purpose of this is to make road driving safer as humans are prone to error even if this doesn't apply to all. The purpose of this is to make travel smoother and safer.
- (b) Distributive justice This project does not in any way harm anyone including animals. As the vehicles are designed in such a manner that the surroundings would not be harmed, it's ethically feasible.

### 4. Schedule feasibility Our project is divided into 4 basic modules. The modules are as follows: 1. Lane Marking 2. Advanced lane marking 3. Traffic sign detection 4. Vehicle detection

- (a) Project plan There are 4 modules as said above. In the first few months, we will be done with basic coding part. Then, we would move to advanced coding part and finally we would be implmenting the same using hardware. As per our timeline ,we are done with basic lane marking an are implementing it's advanced modules. After our code in few months, we would be implementing the same in Raspberry pie.
- (b) Time estimates It took approx. 15 days to get the topic from Persistent Systems (sponsored)  
It took us approx. 10 days to divide the project into modules  
It took us approx. 3 days to decide the project scope of each module individually and altogether  
It took us approx. 20 days to do a survey of algorithmuc approaches  
It took us approx. 5 days to finalize the algorithmic approaches  
It took us approx. 10 days to perform requirement analysis and feasibility study  
It will take approx. 25 days for preliminary report preparation  
It will take approx. 90 days to do system design and coding  
It will take approx. 20 days to do tesing  
It will take approx. 30 days for final report preparation

## 8 Technical Details

### Platform

1. Operating System : Linux

### Software Specification

1. Python 3.0+ - Python is a high-level, interpreted, dynamic programming language. The computer vision , image processing will be implemented using Python scripts. Also the classifiers will be built in in Python.
2. Anaconda 3 - Anaconda is a freemium open source distribution of the Python and R programming languages for large-scale data processing, predictive analytics, and scientific computing, that aims to simplify package management and deployment
3. OpenCV 3 - OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision.
4. TensorFlow - TensorFlow is an open-source software library for machine learning across a range of tasks. It is a system for building and training neural networks to detect and decipher patterns and correlations, analogous to (but not the same as) human learning and reasoning
5. Jupyter - The Jupyter Notebook is an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and explanatory text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, machine learning and much more.

### Hardware Specification

1. Raspberry Pi - Software will be deployed on portable board from Raspberry Pi Family
2. GoPro action camera - Agent will receive percept in the form of video stream through action camera.
3. Nvidia Tegra K1 - GPU supporting the board for compute intensive classification using TensorFlow.

### Dataset

1. GTI vehicle image database
2. Official GTSRB(German Traffic Sign Recognition Benchmark) training set.

## **9 Innovativeness and Usefulness**

1. Today's car crash-avoidance systems and experimental driverless cars rely on radar and other sensors to detect pedestrians on the road. Eg. Google's robotic cars (Waymo) have about 150,000 USD in equipment including a 70,000 USD LIDAR system.
2. The proposed system has a pedestrian detection module that can perform in close to real-time based on visual cues alone. This video-only detection could make systems for spotting pedestrians both cheaper and more effective.
3. Video analysis systems use computer vision, deep neural networks, machine learning algorithms that can be trained to classify images (and other kinds of data) extremely accurately.
4. Modern deep networks can outperform humans in tasks such as recognizing objects, with accuracy rates of over 99.5 percent.

## **10 Market Potential and Competitive Advantage**

1. Existing autonomous cars use expensive hardware such as Lidar, Radar, Velodyne Lasers etc. to detect pedestrians and other objects such as traffic signs on the road. Getting rid of some of that equipment could make the cars cheaper and easier to design.
2. The proposed system has a pedestrian detection and road safety signs detection modules that can perform in close to real-time based on visual cues alone. This video-only detection could make systems for spotting pedestrians and other objects both cheaper and more effective.
3. Among the potential benefits of autonomous cars is a significant reduction in traffic collisions and related costs, including a lower need for insurance. Autonomous cars are also predicted to offer major increases in traffic flow, enhanced mobility for children, the elderly, disabled people, the relief of travelers from driving and navigation chores, lower fuel consumption etc

## 11 Brief Description

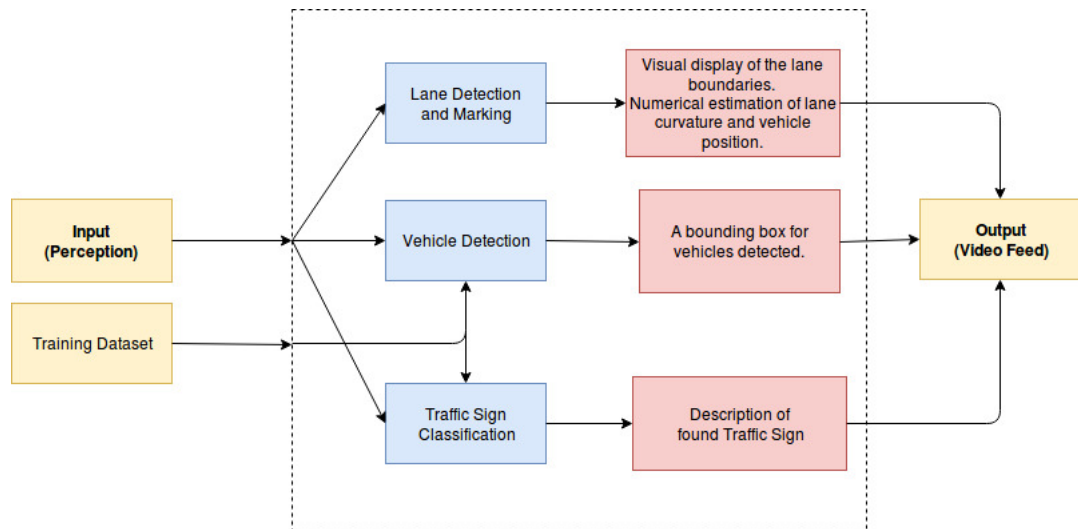


Figure 1: Architecture Diagram

1. Input: System will capture input using action camera as live video feed.
2. Lane Detection and Marking module will split video into frames and will detect edges, lane boundaries. It will also produce numerical estimation of lane curvature and vehicle position.
3. Vehicle Detection module will use classifier to classify objects in video frame as car or not car. It will produce cascade windows for objects classified as cars.
4. Traffic sign classification module will use classifier to classify traffic signs in video frame. It will produce description of every sign.
5. Output: Video feed with annotations from all the modules.



## 12 Major Milestones and Dates

Name	Begin date	End date
• Domain Selection	15/6/17	26/6/17
• Topic Finalization	27/6/17	30/6/17
• Sponsorship Approval	11/7/17	20/7/17
• Feasibility Study and Market Poten...	20/7/17	25/7/17
• Abstract Submission	20/7/17	25/7/17
• System Architecture Design	25/7/17	28/7/17
• Preparing Synopsis	1/8/17	28/8/17

Figure 2: Major Milestones

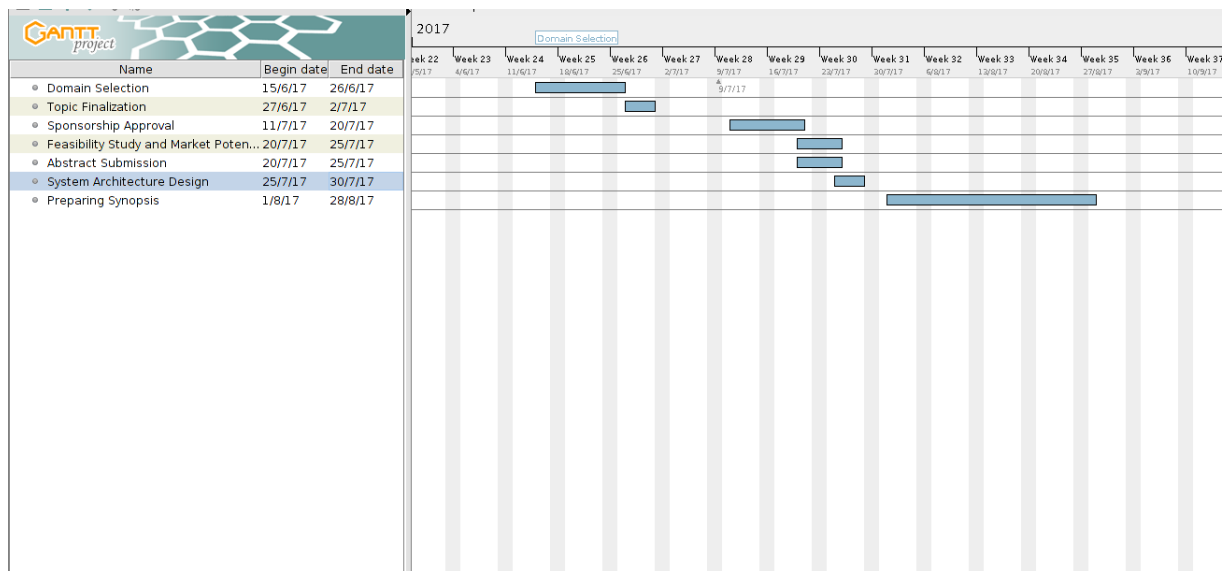


Figure 3: Gantt Chart

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