(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

# SMART ROAD ASSISTANCE

A Report for the Final Evaluation of
Project 2

*Submitted by*

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***in partial fulfillment for the award of the degree of***

**Bachelor of Technology**

**IN**

**Computer Science and Engineering**

**SCHOOL OF COMPUTING SCIENCE AND ENGINEERING**

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**APRIL / MAY- 2020**

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# Chapter 1. Abstract


- One of the main challenges for advanced driver assistance systems (ADAS) is the environment perception problem.
- One factor that makes ADAS hard to implement is the large amount of different conditions that have to be taken care of. The main sources for condition diversity are lane and road appearance, image clarity issues and poor visibility conditions.
- A review of current lane detection algorithms has been carried out and based on that a lane detection algorithm has been developed and implemented on a mixed criticality platform.
- The final lane detection algorithms consists of preprocessing steps where the image is converted to gray scale and everything except the region of interest (ROI) is cut away. OpenCV, a library for image processing has been utilized for edge detection and hough transform.
- An algorithm for error calculations is developed which compares the center and direction of the lane with the actual vehicle position and direction during real experiments.
- The lane detection system is implemented on a Raspberry Pi which communicates with a mixed criticality platform. The demonstrator vehicle can achieve a measured speed of 3.5 m/s with reliable lane keeping using the developed algorithm.

# Chapter 2. Introduction

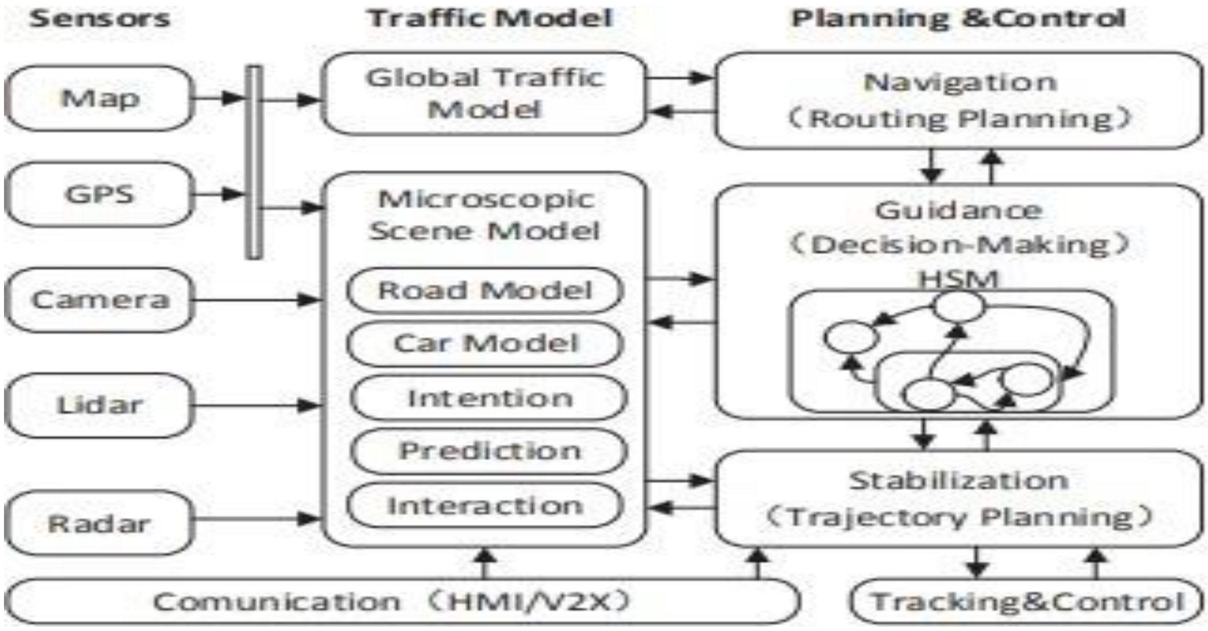
Using the machine learning algorithms and python it will predict the width of the road .It will also tell the distance from the roadside and also guide for overtaking the vehicles.

The trained machine become the powerful feature in the driverless car as the vehicle get proper assistance in the overtaking and parking also .It can also be used in the cruise control of the car make the more impact of the car and easy in controlling the car.

Active safety is currently a key topic in the automotive industry, which fosters the development of Autonomous Vehicle functions. Various advanced driver assistance systems (ADAS) and active safety systems have the potential to improve road safety, driver comfort, fuel economy, and traffic flow by assisting the driver during different driving conditions. It is estimated that human error is a contributing factor in more than 90% of all accidents. In order to save the human lives caused by road accidents, it is hence of interest to develop such systems using modeling and simulation tools which is quick and more efficient as compared to the real driving testing. Overtaking is one of the most complex maneuvers with the high risk of collision (75% human error) so the automation of this maneuver still remains one of the toughest challenges in the development of autonomous vehicles.

Since overtaking is one of the complex maneuvers and so many factors affect it, the automation of this maneuver has been considered to be one of the toughest challenges in the development of autonomous vehicles. Overtaking involves a great interaction between both longitudinal (throttle and brake) and lateral (steering) actuators. Nowadays, in the field of driver assistance systems and automated driving, development approaches for lateral maneuver control are the very big challenge.

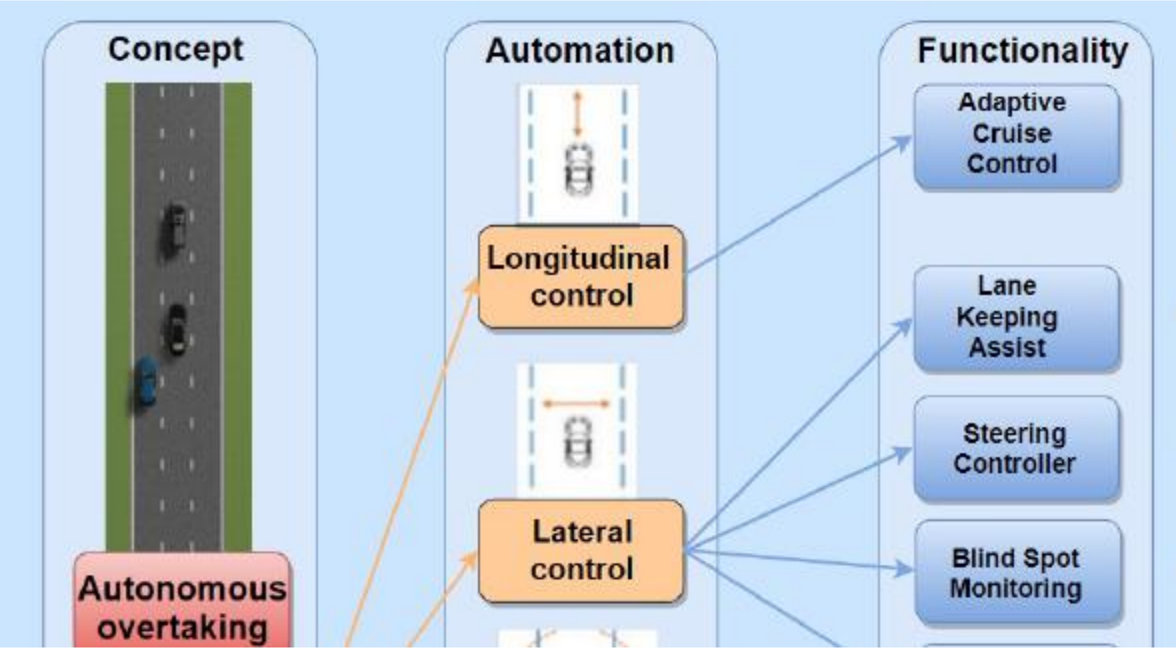
# Chapter 3. Existing System




A tracking problem is usually not an initial value problem, and one needs to harvest the boundary conditions at the final time. Even if one assumes that, a solution to the boundary value problem exists, the nature of the trajectory cannot be guessed from the problem description if the system fails to have an analytic solution, as also pointed out. A numerical procedure is the norm in such cases and requires an assumption that the system remains reachable under the assumed set of initial values and sampling interval.

The possible solution for comfort oriented vehicle following with leading vehicle movement prediction treated as disturbance controller is presented. It is dealing with the execution of optimal speed trajectory planning is done in a way that modifying an optimal speed trajectory leads to the smallest deviation from the desired speed while the vehicle is moving. These approaches are treating the problem locally and partially and don't give an energy consumption based decision if a vehicle should overtake.

# Chapter 4. Proposed System




This project presents an advanced lane detection technology to improve the efficiency and accuracy of real-time lane detection. The lane detection module is usually divided into two steps: image pre-processing and the establishment and matching of line lane detection model.

Figure 1 shows the overall diagram of our proposed system where lane detection blocks are the main contributions of this paper. The first step is to read the frames in the video stream. The second step is to enter the image pre-processing module. What is different from others is that in the pre-processing stage we not only process the image itself but also do colour feature extraction and edge feature extraction. In order to reduce the influence of noise in the process of motion and tracking, after extracting the colour features of the image, we need to use Gaussian filter to smooth the image. Then, the image is obtained by binary threshold processing and morphological closure. These are the pre-processing methods mentioned in this project.

In this project I will attempt to find lane lines from a dash cam video feed. Once we detect lane lines, we will mark them on the original video frame and play it back. This all will be done online and without any lag using OpenCV functions.

Our approach here would be to develop sequence of functions to detect lane lines. We will use a ‘sample’ image while writing this functions, and once we are able to detect lane lines on few ‘sample’ images successfully, we will club complete program into a function which can accept live feed image and return the same image frame with lane lines highlighted.

Using the machine learning algorithms and python it will predict the width of the road .It will also tell the distance from the roadside and also guide for overtaking the. It can also used in the cruise control of the car make the more impact of the car and easy in controlling the car. The trained machine will able to calculate and it will predict the width of the lane that will help to drive the car in its lane with the proper guidance.

**Canny Edge Detector Algorithm -**The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. It was developed by John F. Canny in 1986. Canny also produced a computational theory of edge detection explaining why the technique works.

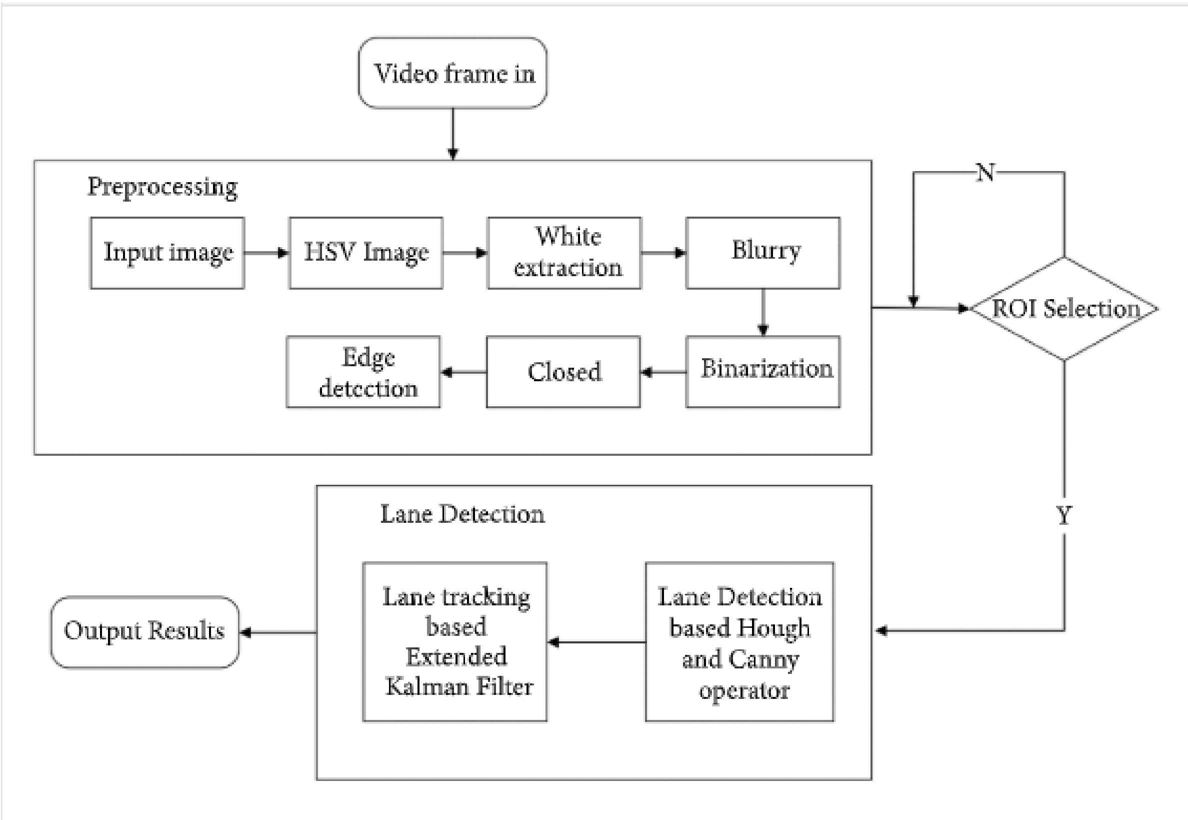
Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed.

- Detection of edge with low error rate, which means that the detection should accurately catch as many edges shown in the image as possible
- The edge point detected from the operator should accurately localize on the center of the edge.
- A given edge in the image should only be marked once, and where possible, image noise should not create false edges.

**Process of Canny Edge Detection Algorithm**

1. Apply Gaussian filter to smooth the image in order to remove the noise
2. Find the intensity gradients of the image
3. Apply non-maximum suppression to get rid of spurious response to edge detection
4. Apply double threshold to determine potential edges
5. Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges

## Block Diagram



# Chapter 5. Implementation

## Program Code:

```
import cv2

import numpy as np

def make_coordinates(image,line_parameters):

    slope,intercept=line_parameters

    print(image.shape)

    y1=image.shape[0]

    y2=int(y1*(3/5))

    x1=int((y1-intercept)/slope)

    x2=int((y2-intercept)/slope)

    return np.array([x1,y1,x2,y2])

return



def average_slope_intercept(image,lines):

    left_fit=[]

    right_fit=[]

    for line in lines:
```

```
x1,y1,x2,y2=line.reshape(4)
        parameters=np.polyfit((x1,x2),(y1,y2),1)
        slope=parameters[0]
        intercept=parameters[1]
        if slope <0:
            left_fit.append((slope,intercept))
        else:
            right_fit.append((slope,intercept))
    left_fit_average=np.average(left_fit,axis=0)
    right_fit_average=np.average(right_fit,axis=0)
    left_line=make_coordinates(image,left_fit_average)
    right_line=make_coordinates(image,right_fit_average)
    return np.array([left_line,right_line])
def canny(image):
    gray=cv2.cvtColor(image,cv2.COLOR_RGB2GRAY)
    blur=cv2.GaussianBlur(gray,(5,5),0)
    canny=cv2.Canny(blur,50,150)
    return canny
```

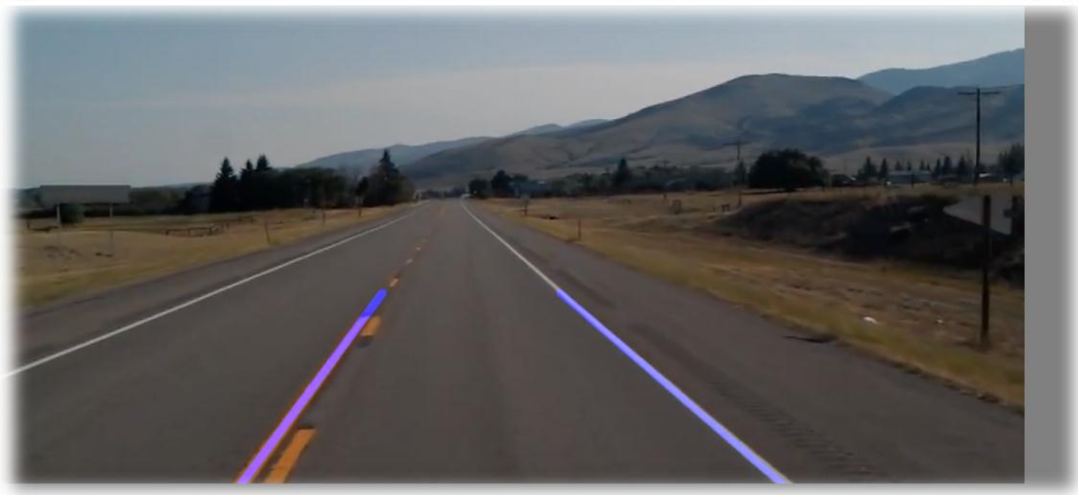
```
def display_lines(image,lines):
    line_image=np.zeros_like(image)
    if lines is not None:
        for x1,y1,x2,y2 in lines:
            cv2.line(line_image,(x1,y1),(x2,y2),(255,0,0),10)
    return line_image
def region_of_interest(image):
    height=image.shape[0]
    polygons=np.array([
    [(200,height),(1100,height),(550,250)]
    ])
    mask=np.zeros_like(image)
    cv2.fillPoly(mask,polygons,255)
    masked_image=cv2.bitwise_and(image,mask)
    return masked_image
cap=cv2.VideoCapture("test2.mp4")
while(cap.isOpened()):
    _, frame=cap.read()
```

```
    canny_image=canny(frame)
      cropped_image=region_of_interest(canny_image)

lines=cv2.HoughLinesP(cropped_image,2,np.pi/180,100,np.array([]),minLineLength=40,maxLineGap=5)
    averaged_lines=average_slope_intercept(frame,lines)
    line_image=display_lines(frame,averaged_lines)
    combo_image=cv2.addWeighted(frame,0.8,line_image,1,1)
    cv2.imshow("result",combo_image)
    if cv2.waitKey(1)==ord('q'):
        break
cap.release()
cv2.destroyAllWindows
```

# Chapter 6. Output / Screenshot

**Input (Sample Image)**



**Output Screen**

# Chapter 7. Conclusion

The problem of autonomous highway overtaking was solved. The test protocol for highway overtaking assist was developed which was further used for the development of an automated driving system for the autonomous highway overtaking. The developed test protocol was validated analytically using mathematical equations and the automated driving system was tested virtually. The simulation results were found to be in accordance with the desired host vehicle behavior. The system drives the host vehicle through the selected use cases in a safe and efficient manner, while interacting with target vehicles operating in the traffic environment. The proposed autonomous highway overtaking system has the following characteristics:

• Safe, comfortable, and robust: The safety of the developed system was guaranteed by ensuring that the host vehicle remains outside the safe time gap during overtaking. Also, the host vehicle was able to execute the overtaking maneuver without exceeding the safe limits of longitudinal acceleration, heading angle, yaw rate, and lateral velocity, it was concluded that the developed fuzzy controller was suitable for application to the steering control even at a higher speed. Thus, the system is robust enough.

• Feasible and modular framework of the autonomous highway overtaking system The developed system is feasible since it uses the sensors and ADAS systems  Also, the development of subsystems is performed independently which might be beneficial to the future optimization of the system under study and implementation into a real vehicle. The system can be said to be optimized for real-time implementation.

# Chapter 8. References

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