# AUTOMOBILE SAFETY SYSTEM USING YOLO AND CASSANDRA

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***Abstract :*** With the increasing human population we see an increased number of vehicles resulting in accidents, as much as, these accidents have become a common thing that we sometimes just neglect and move on. During Covid time we have witnessed a huge number of deaths all over the world and the world got shut down because of it. But what we don't know is those road accidents are responsible for a death every four minutes in India and according to WHO each year more than 1.3 million or 13 Lack people die due to road accidents. The cause of a whopping majority of these accidents is drunk driving, fatigue and carelessness which can be prevented if the driver is warned in time. In this study, we have proposed a deep learning-based model for driver and vehicle safety on the roads.

***Keyword:*** **Deep Learning, Artificial Intelligence, Self-Driving, Open CV, Cassandra, Yolo, Autonomous Vehicle, Lane Detection**

## I. Introduction

When a person is driving a vehicle then they are using their vision and their limbs for vehicle movement and their brain and nervous system plays as the mind of the vehicle. The scope for any type of error increases due to the complexity of the human body. There can be recognition errors on the part of drivers like inadequate surveillance or internal or external disturbance/distraction. There can be decision-making errors like speeding or aggressive driving and there can also be judgement error on the part of the driver. But we have observed in our lives that when a machine operated on its own with zero to a minimal human involvement then the scope of such errors can be reduced. Due to such reasons, the concept of the Automobile Safety System arises which we will further understand by getting familiar with certain terms.

Autonomous Vehicle: A vehicle which has the ability to operate on its own with zero to minimal human interaction needed.

Lane Detection: Detects the lane in which the vehicle is driving which helps to determine the further path of the vehicle and helps to provide a more accurate position of the vehicle.

Drowsiness: It is a state in which a human body experiences excessive sleepiness which can be caused due to sleep deprivation, alcohol, drugs, medicine side effects or excessive eating.

Deep Learning : Deep learning comes from the machine learning family which teaches the machine to do complex functions that a human brain performs. It basically tries to stimulate the function of the human brain.

Face Detection : It is a technology which is used to identify human faces in images

We propose a system to assist drivers and help them achieve a more secure and reliable driving experience by adding a lane detection and drowsiness system. Lane detection will help the driver to see their path clearly ahead of them and will also help the to safely switch lanes on a busy road or highway. By installing a drowsiness system the driver will get an alert whenever the system detects that the driver is getting sleepy. This system of ours will help the driver ensure their and their passengers' and vehicle's safety.

## II. Literature Review

Every year the lives of millions are lost and between 20 and 50 million people suffer injuries with many incurring a disability as a result. There is a huge need to prevent these deaths and that can be done using computational systems to help the driver in better vehicle management. As this issue not only costs human lives it also accounts for about 3% loss in GDP in most countries. [1] Lane detection needs to be robust but it sometimes faces issues due to illumination, lane shapes and complicated disturbances. We can overcome these issues by using multiple visual cues with prior knowledge and spatial-temporal information. [2] Lane and vehicle location is difficult to distinguish for an individual so various techniques should be tried and chosen based on result accuracy. Experiments should be conducted with images covering various natural disturbances that might be present on the road and based on the experiments we must evaluate the proposed method for complicated disturbances on road. [3]

A large number of approaches have been proposed to date. However, still it is considered a staggering task to implement these types of systems in vehicles because of its huge cost and also a special class of vehicles have the ability for this system to be implemented. [4] What we are doing is that we are making this system very cost-efficient so that it can be installed in any vehicle. We are using mobile phone camera for image collection as it is accessible to everyone.

For drowsiness , In methods developed based on physiological signals, some electrodes are attached to the body to detect the signals from brain and heart. This method would be irritating and is considered as a distraction for a driver. In another methods developed based on the driver's performance, a lot of time is required to analyse driver's performance which leads to low accuracy, In this case if a driver falls asleep for a few seconds then the system takes time to register this. [5] – [6]

The parameters for drowsiness which we use is human eyes. The studies have shown that amongst various facial features, eyes are the most important to detect the level of sleepiness. We can do this by constantly monitoring the driver's face and check every frame for the signals of sleepiness. We can do this in real time using Yolo algorithm which helps to process image data in real time. [7] – [8]

Eyes are an important parameter for checking drowsiness but other conditions like yawning , head and mouth movement can also be taken in account and we do this by teaching our system through a number of images and after training the system is capable of monitoring the driver's movements. Traffic sign recognition is a part of advance driver assistance system which helps driver to recognise traffic signs ahead using front camera and image recognition, as it can help driver in many ways like warning if the vehicle is moving above the speed limit etc. [9]

### i. Open CV

ANN It is an open-source computer vision and machine learning software library. It was built to give a structure for computer vision applications and to accelerate its uses. This library has over thousand algorithms. These algorithms can be used for many purposes like face detection, object identification, detection of actions in a video, movement tracking in camera or video, finding similar images for a large dataset, and much more. We used Open CV because our study required a huge amount of work on image processing and performing computer vision tasks. It is also very useful in many programming languages and also when we are working on different platforms.

### ii. You Only Look Once (YOLO)

It is an algorithm that detects and recognizes various objects in an image and that to in real time. This algorithm employs conventional neural networks to detect objects in real-time in a picture[10].

Convolutional Neural Network : It is a set of algorithms that are designed to mimic the behaviour or functioning of a human brain on a dataset and allowing computers to recognise patterns. Using a convolutional neural network instead using an artificial neural network in an image captured by a camera increases performance and prediction rate of an object. [11] – [12]

We use Yolo because it is fast and good for real time processing and also provides more accurate predictions as Yolo sees an image completely at once rather than looking at certain regions at a time.

### iii. Cassandra

Cassandra is a distributed database management system which is open source and developed by Apache Software Foundation. We use it to manage our fast moving data which we have in form of frames in lave volumes. It can store large terabytes of data and has fast reading speed. [13]

## III. Methodologies:

### i. Data collection:

The data for the lane detection and vehicle driver drowsiness detection has been taken by camera of us and the data for the training of traffic signal is being taken from Kaggle.

### ii. Lane Detection-

In this paper, we proposed a new lane detection pre-processing and ROI selection methods to design a lane detection system. The main idea is to add white extraction before the conventional basic pre-processing. Edge extraction has also been added during the pre-processing stage to improve lane detection accuracy. We also placed the ROI selection after the proposed pre-processing. Compared with selecting the ROI in the original image, it reduced the non-lane parameters and improved the accuracy of lane detection. Currently, we only use the Hough transform to detect straight lane and EKF to track lane and do not develop advanced lane detection methods. In the future, we will exploit a more advanced lane detection approach to improve the performance. In following image, we can see that the lane is being detected by measuring the radius of curvature. With automation in the automobile industry and introduction of artificial intelligence, this mechanism can be linked with the mechanical functioning of the vehicle resulting in easy drive and reduction in the rates of accident. The vehicle will automatically detect the lane and signal the driver when the lane gets changed.

### 2.1 Camera correction and image distortion removal:

To compute the camera the transformation matrix and distortion coefficients, we use multiple pictures of a *chessboard* on a flat surface taken by the same camera. OpenCV has a convenient method called find Chessboard Corners that will identify the points where black and white squares intersect and reverse engineer the distortion matrix this way.

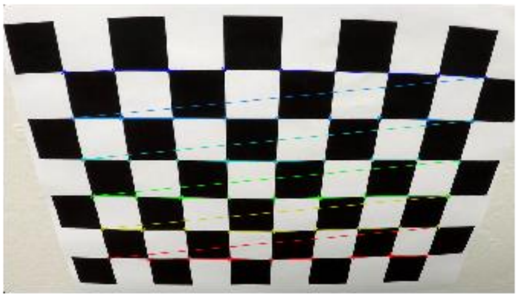

**Figure 1: Chessboard Corners**

We apply color and edge thresholding in this section to better detect the lines, and make it easier to find the polynomial that best describes our left and right lanes later.

### 2.1.1 Color Thresholding:

On the RGB components, we see that the blue channel is worst at identifying yellow lines, while the red channel seems to give best results. For HLS and HSV, the hue channel produces an extremely noisy output, while the saturation channel of HLS seems to give the strong results; better than HSV's saturation channel. conversely, HSV's value channel is giving a very clear grayscale-ish image, especially on the yellow line, much better than HLS' lightness channel.


**Figure 2: Undistorted Image/ HLS Color Thresholded Image**

As you can see above, our HLS color thresholding achieves great results on the image. The thresholding somewhat struggles a little with the shadow of the tree on the yellow line further up ahead.

### 2.1.2 Gradient Thresholding:

We have decided to use LAB's L channel as our single-channel image to serve as input to the Sobel functions.

### 2.1.3 Combining both

We naturally combine both color and Sobel thresholded binary images, and arrive at the following results:

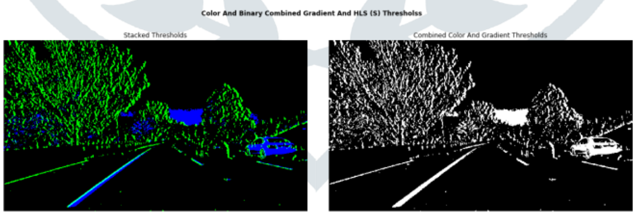


**Figure 3: Color and Binary combined Gradient and HLS (S) Thresholds**

#### 2.1.3.1 Perspective Transform

We now need to define a trapezoidal region in the 2D image that will go through a perspective transform to convert into a bird's eye view.

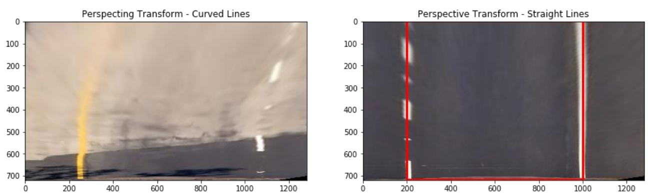


**Figure 4: Bird's Eye View**

### iii. Driver Drowsiness Detection-

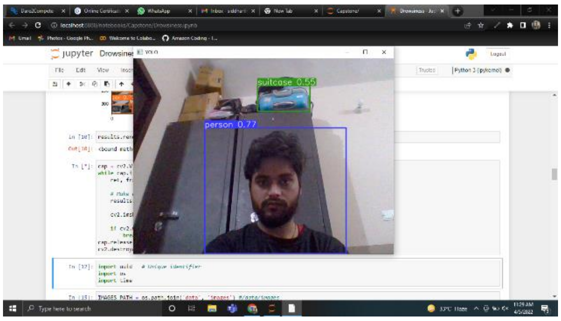


**Figure 5: Result Detection**

This work presents a technique of managing driver drowsiness using an assistant agent with a DRD (detection, recognition, decision) approach. We use Yolov5 Algorithm for this and implement using OpenCV. YOLO is an algorithm that uses neural networks to provide real-time object detection. We use this algorithm because of its speed and accuracy. YOLO is an abbreviation for the term 'You Only Look Once'. This is an algorithm that detects and recognizes various objects in a picture (in real-time). Object detection in YOLO is done as a regression problem and provides the class probabilities of the detected images. In this model we load sample images for "Awake" and "Drowsy" 20 each for recognition then we label them and make clone. First, the image is divided into various grids. Each grid has a dimension of S x S. YOLO has three techniques in this we use Bounding box regression to identify in which camera detect the driver face and compare with source image and give result accordingly. This can be used with the internal camera system of vehicle which will monitor the drivers face and detect the drowsiness if found and give signal for the drowsiness. With this the chances of accidents due drowsiness can be reduced.

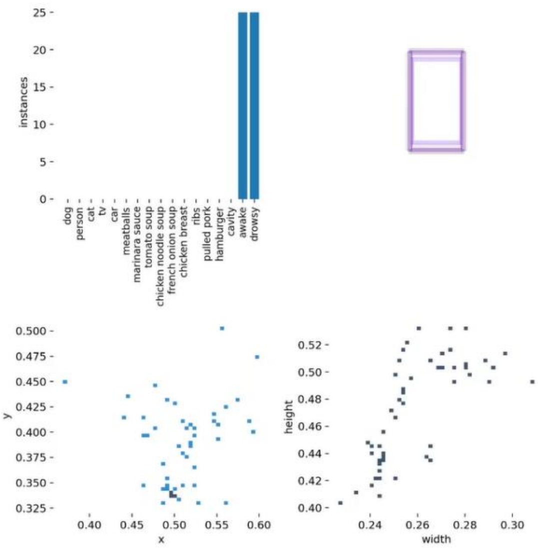


**Figure 6: Result Labelling Graph**

### 3.1 Signal Detection-

In our research, we have demonstrated our initial efforts to establish a DL framework for multi-signals detection and modulation classification problem. We use CNN Algorithm and implement normally using OpenCV. Signal detection program detects the traffic light and accordingly tells the action. If the signal is Red then it tells to stop and if its green then it tells to move forward. In future this system can be integrated with the mechanical system which will reduce the chances of accidents due to breaking of signals. More-over it will automatically turn off the car engine when the light is red and start when it is going to green saving the fuel also.

#### 3.1.1 Pre processing steps:

We convert our image into grayscale image and applied image normalization. We center the distribution of the image dataset by subtracting each image by the dataset mean and divide by its standard deviation. This will help to treat image uniformly.

3.1.1.1 **Architecture**:

The network is composed of 3 convolutional layer with depth doubling at next layer — using ReLU as the activation function.

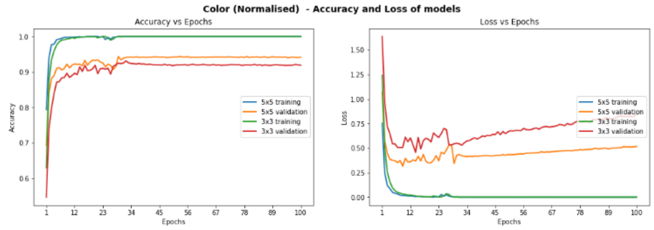


**Figure 7: Accuracy and Loss of Model(Color)**

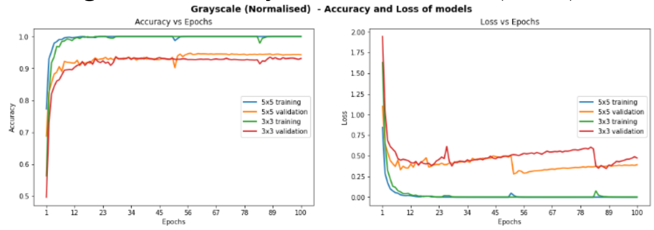


**Figure 8: Accuracy and Loss of Model(GrayScale)**

### 3.1.1.2 **Histogram equalization:**

As some of our images suffer from low contrast (blurry, dark), we will improve visibility by applying OpenCV's Contrast Limiting Adaptive Histogram Equalization function.

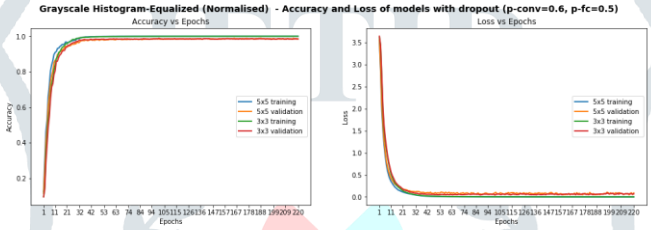


**Figure 9: Histogram Equalisation Graph**

## IV. Results:

We draw the inside the of the lane in green and *unwarp* the image, thus moving from bird's eye view to the original undistorted image. Additionally, we overlay this big image with small images of our lane detection algorithm to give a better feel of what is going on *frame by frame*. We also add textual information about lane curvature and vehicle's center position:

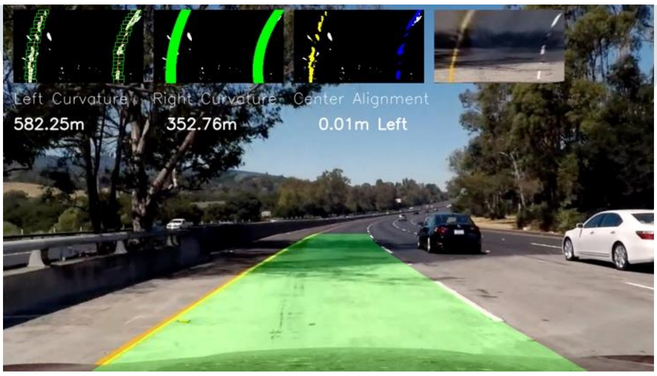


**Figure 10: Lane Detect**

We decided to test our model on new images as well, to make sure that it's indeed generalised to more than the traffic signs in our original dataset.


**Figure 11: Traffic Sign (Color)**

The first step we took was to apply the same CLAHE to those new images, resulting in the following:

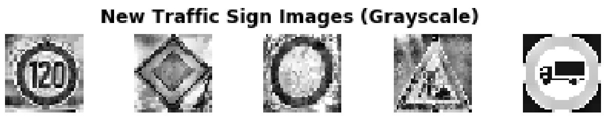


Figure 12: Traffic Sign (Grayscale)

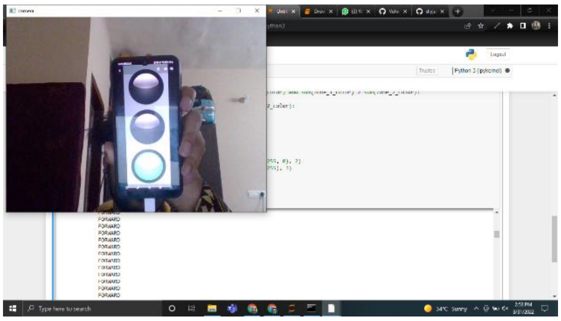

Figure 13(a): Result Detect for green

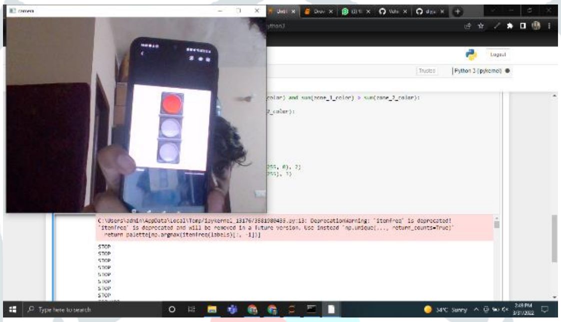

Figure 13(b): Result Detect for Red

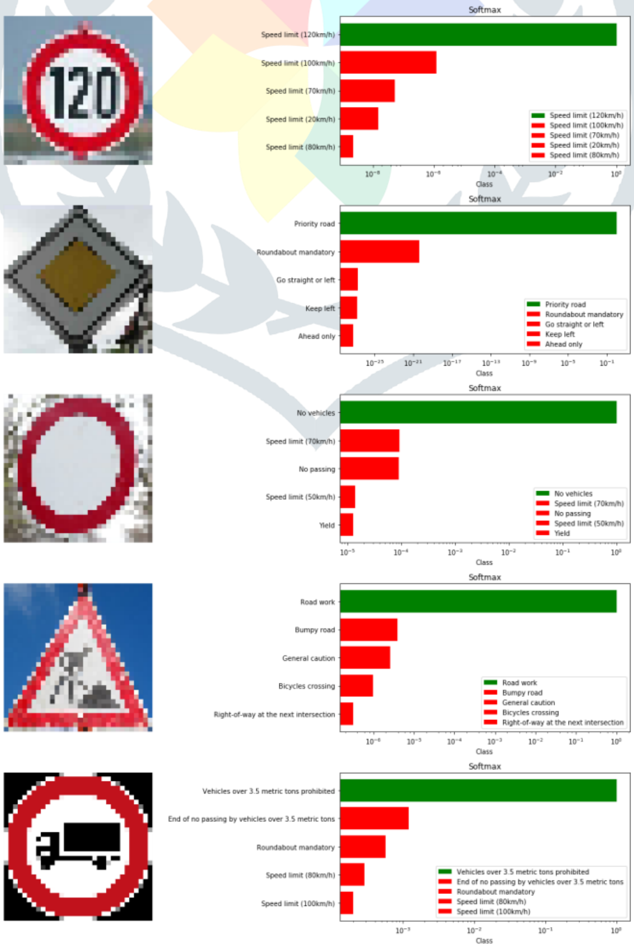


Figure 14: Various Traffic Sign Chart

We could explore blurring/distorting our new images or modifying contrast to see how the model handles those changes in the future.

### i. Accuracy Chart:

Performance of the model in predicting drowsiness level with the testing dataset: mean square error (MSE), standard deviation (STD), according to whether dataset is used with (1) or without driving time (0), participant information, and source of recorded information. The * symbol indicates the worst performance and the # symbol the best performance. The best and worst performance are also highlighted in bold.

| Driving Time | Participant information | Dataset | Source | MSE | STD | \|Error\|95% | % Error <5 |
|---|---|---|---|---|---|---|---|
| 0 | 0 | Testing | All | 33.64 | 7.63 | 9.29 | 0.79 |
| 0 | 0 | Testing | Behavioral | 23.61 | 3.15 | 8.12 | 0.86 |
| 0 | 0 | Testing | Car | **60.09*** | 6.19 | 13.12 | 0.73 |
| 0 | 0 | Testing | Physiological | 43.77 | 6.24 | 11.47 | 0.74 |
| 0 | 1 | Testing | All | 28.26 | 2.82 | 8.79 | 0.82 |
| 0 | 1 | Testing | Behavioral | 22.83 | 4.03 | 7.98 | 0.89 |
| 0 | 1 | Testing | Car | 50.22 | 8.84 | 12.11 | 0.73 |
| 0 | 1 | Testing | Physiological | 41.82 | 4.11 | 11.83 | 0.74 |

**Table 1: Performance of the model with the testing dataset**

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