JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY

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MINOR II

MID EVALUATION REPORT

AUTONOMOUS CAR USING DEEP LEARNING

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PROBLEM STATEMENT -

Nearly 1.25 million people die every year road accidents , on average 2087 deaths each day all over the world. An additional 20-50 million people are injured or disabled.

More than half of those accidents have happened with young adults 15 - 44 years. Road traffic crashes rank as the 9th leading cause of death and account for 2.2% of all deaths globally. Road crashes are the leading cause of death among young people ages 15-29, and the second leading cause of death worldwide among young people ages 5-14. Each year nearly 400,000 people under 25 die on the world's roads, on average over 1,000 a day.

DoT researchers estimatethat fully autonomous vehicles, also known as self-driving cars, could reduce traffic fatalities by up to 94 percent by eliminating those accidents that are due to human error. So there are millions of lives that could be saved around the world every decade with fully autonomous cars.

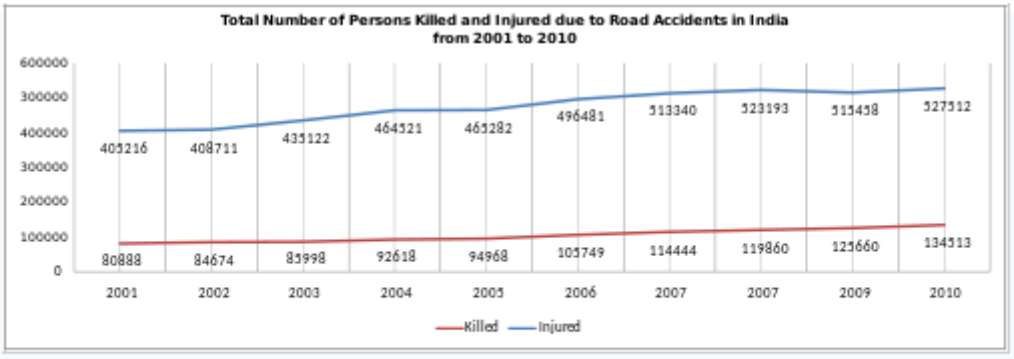
Elderly drivers and teenagers are particularly likely to benefit from autonomous vehicles because the cars can monitor a situation that a driver might not be able to themselves, said Wayne Powell, vice president of electrical engineering and connected technologies for Toyota Motors North America.

Cars with automated technology have sensors that never lose vigilance. "They're always looking for pedestrians. They're always looking for the edge of the road. They're always watching the car in front. They don't become distracted or drunk, and I think that's really the main reason why most experts would say that there is a definite possibility that automation can significantly reduce those human error caused fatal crashes.

The biggest problem automated vehicles solve is that human beings are not well-suited to traveling at high speeds. As speed increases, our time and distance perception degrades. We do not have a sufficient range of lateral vision and no rear vision. We are limited in our

ability to focus and process data and we tend to focus on one thing at a time (which leads to distraction from the task of driving). In short, we make mistakes behind the wheel and these mistakes (including outright negligence like driving under the influence) are the primary cause in more than 90% of accidents.

Traffic collisions in Indiaare a major source of deaths, injuries and property damage every year. The National Crime Records Bureau(NCRB) 2016 report states there were 496,762 roads, railways and railway crossing-related traffic collisions in 2015.Of these, road collisions accounted for 464,674 collisions which caused 148,707 traffic-related deaths in India. The three highest total number of fatalities were reported in Uttar Pradesh, Maharashtraand Tamil Nadu, and together they accounted for about 33% of total Indian traffic fatalities in 2015.



Total number of persons killed and injured due to road accidents, from 2001 to 2010

Contributing factors

Recently the number of road vehicles has increased enormously thanks to the technological achievements in the motor industry and very precisely the availability of low rates. With this remarkable growth, the number of accidents is as well in an infinite rise year after year, due to different causes, in which the ignorance of traffic signs is considered as a major cause of these lasts.

ABOUT PROJECT

We are creating an Autonomous Car in our Minor II Project in order to contribute something to solve the above problem.
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Our project will use the following technologies -

Train Convolution Neural Network to identify between various traffic signal. Nowadays, more and more object recognition tasks are being solved with Convolutional Neural Networks (CNN). Due to its high recognition rate and fast execution, the convolutional neural networks have enhanced most of computer vision tasks, both existing and new ones.

In this project, we propose an implementation of Traffic sign recognition system using a convolution neural network.

Computer Vision techniques via OpenCV to identify Lanes for self driving car.

During the driving operation, humans use their optical vision for vehicle maneuvering. The road lane marking acts as a constant reference for vehicle navigation. One of the prerequisites to have in a self-driving car is the development of an Automatic Lane detection system using an algorithm.

Computer vision is a technology that can enable cars to make sense of their surroundings. It is a branch of artificial intelligence that enables software to understand the content of image and video.

Train a Perceptron based neural network to classify between binary classes.

Train Deep neural Network to fit complex datasets.

Keras a power Neural Network library written in Python.

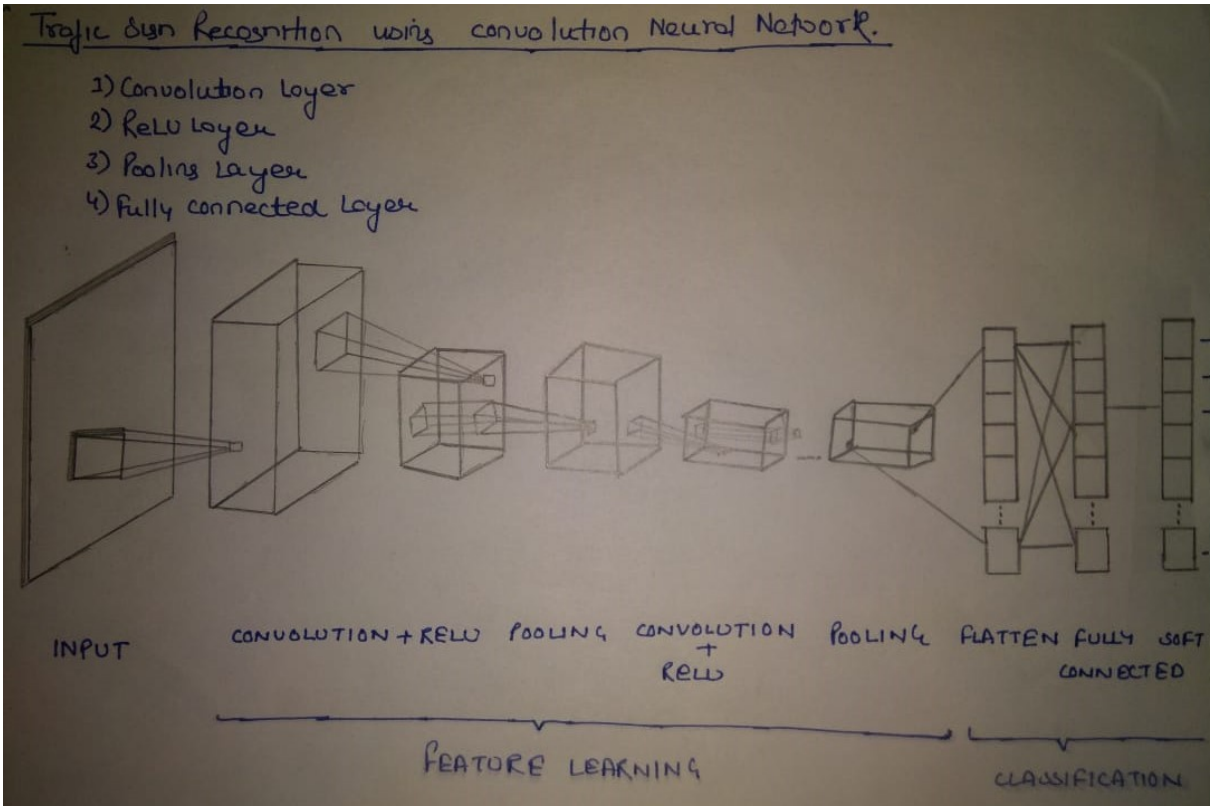
LITERATURE SURVEY

1) Traffic sign recognition using convolutional neural networks

Computers see images as an array of pixels. (h*w*d)
h - height
w - width
d - dimensions

d = 3 (for colored images) d
= 1 (for grayscale images)

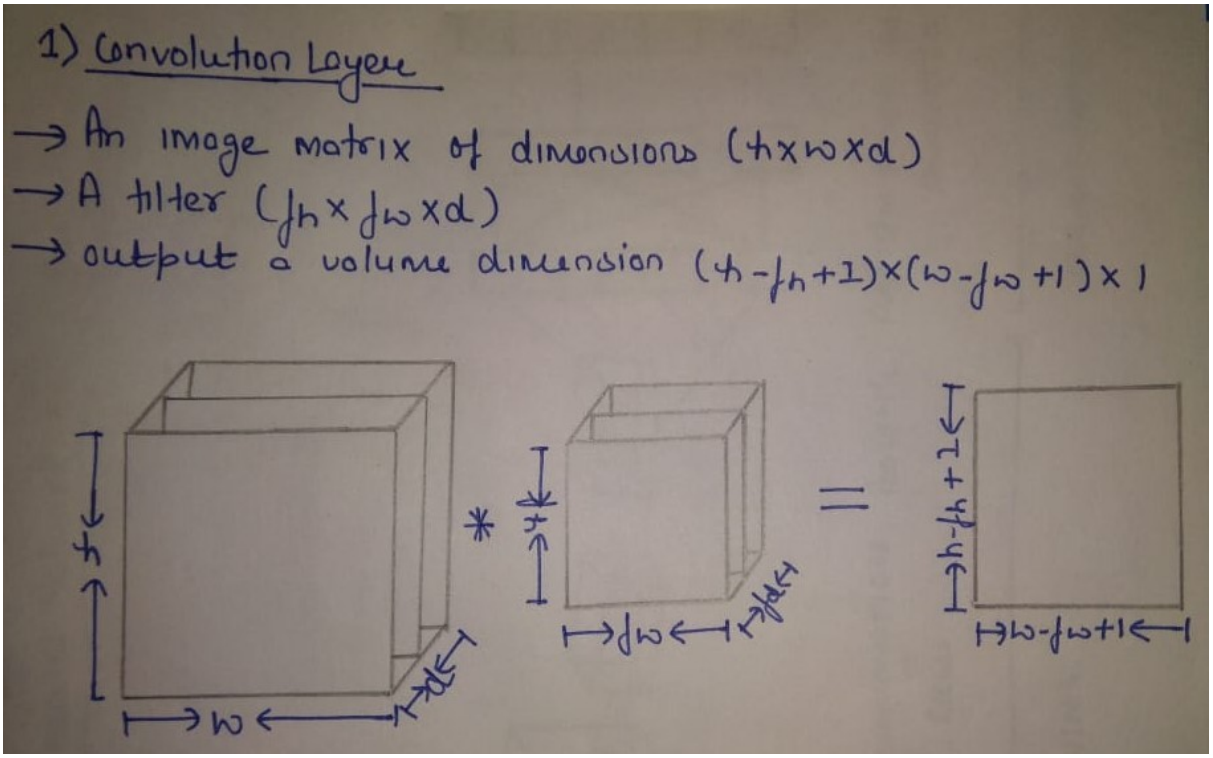
CNN image classifications take an input image, process it and classify it under certain categories (Eg., Dog, Cat, Tiger, Lion). Computers see an input image as an array of pixels and it depends on the image resolution. Based on the image resolution, it will see h x w x d(h = Height, w = Width, d = Dimension). Eg., An image of 6 x 6 x 3 array of matrix of RGB (3 refers to RGB values) and an image of 4 x 4 x 1 array of matrix of grayscale image.
Technically, deep learning CNN models to train and test, each input image will pass it through a series of convolution layers with filters. Pooling, fully connected layers (FC) and apply Softmax function to classify an object with probabilistic values between 0 and 1. The below figure is a complete flow of CNN to process an input image and classifies the objects based on values.



1) Convolution Layer
2) ReLU Layer
3) Pooling Layer
4) Fully Connected Layer

1) Convolution Layer

Convolution is the first layer to extract features from an input image. Convolution preserves the relationship between pixels by learning image features using small squares of input data. It is a mathematical operation that takes two inputs such as image matrix and a filter or kernel.



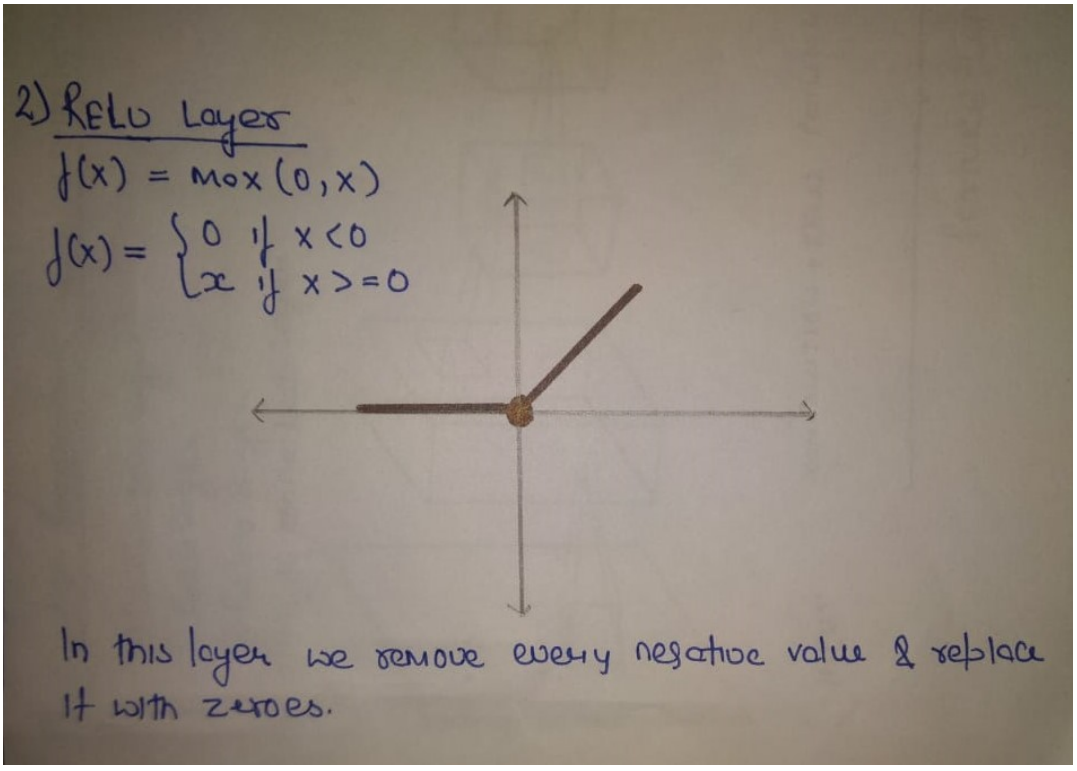
Example - Consider a 5 x 5 whose image pixel values are 0, 1 and filter matrix 3 x 3 as shown in beloThen the convolution of 5 x 5 image matrix multiplied with 3 x 3 filter matrix which is called **“Feature Map”**as output shown in below

Convolution of an image with different filters can perform operations such as edge detection, blur and sharpen by applying filters.

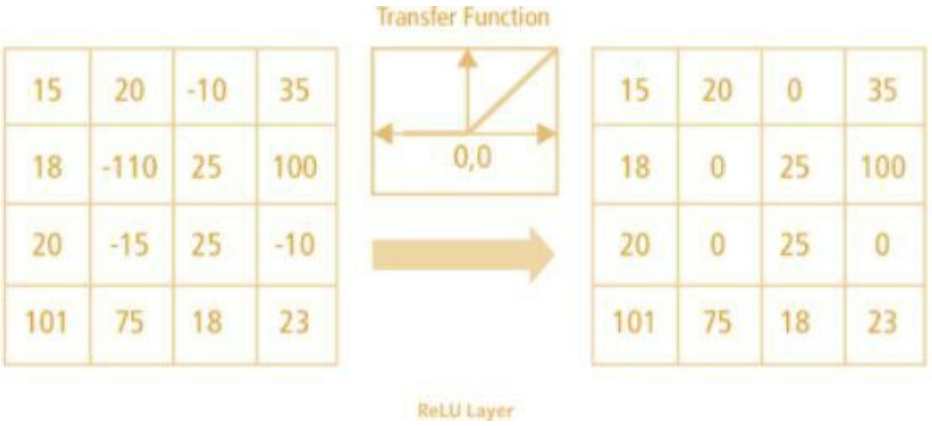
2) ReLU Layer

ReLU stands for Rectified Linear Unit for a non-linear operation.

The output is **(x) = max(0,x).**



In this layer we remove every negative value from the filtered image and replace it with zeroes. This is done to avoid the values summing up to zeroes.



There are other nonlinear functions such as tanh or sigmoid that can also be used instead of ReLU. Most of the data scientists use ReLU since performance wise ReLU is better than the other two.

Eg - Sigmoid = 1/(1 + exp(x))

3) Pooling Layer

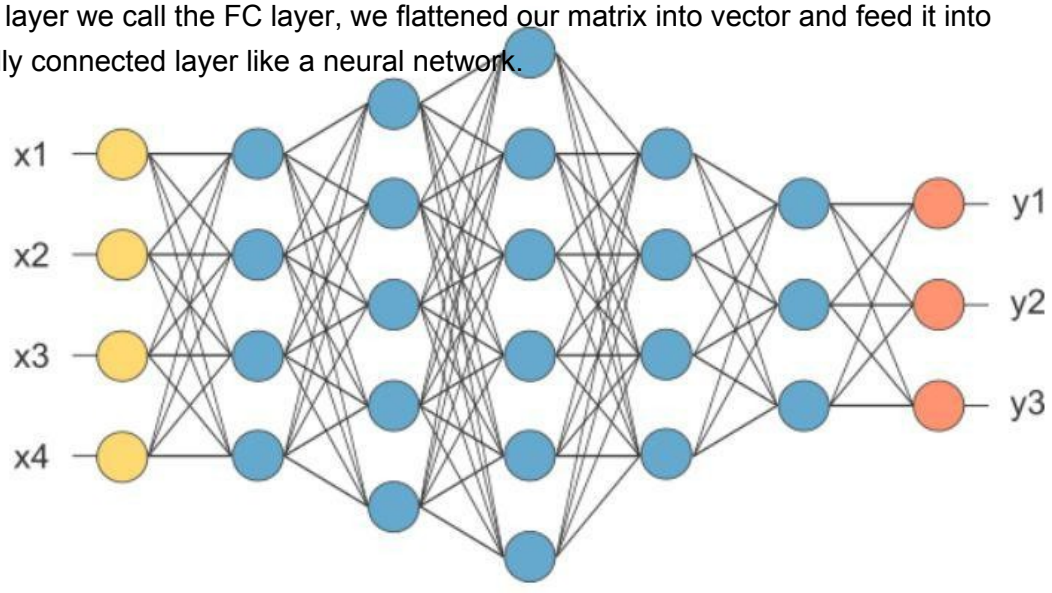
Pooling layers section would reduce the number of parameters when the images are too large. Spatial pooling is also called subsampling or downsampling which reduces the dimensionality of each map but retains important information. Spatial pooling can be of different types:

Max pooling
Average pooling
Sum pooling

Max pooling takes the largest element from the rectified feature map. Taking the largest element could also take the average pooling. Sum of all elements in the feature map call as sum pooling.

4) Fully Connected Layer

The layer we call the FC layer, we flattened our matrix into vector and feed it into a fully connected layer like a neural network.



In the above diagram, the feature map matrix will be converted as vector (x1, x2, x3, …). With the fully connected layers, we combined these features together to create a model. Finally, we have an activation function such as softmax or sigmoid to classify the outputs as cat, dog, car, truck etc.,

2) **Lane Detection for Autonomous Vehicles using OpenCV Library**

For vehicles to be able to drive by themselves, they need to understand their surrounding world like human drivers, so they can navigate their way in streets, pause at stop signs and traffic lights, and avoid hitting obstacles such as other cars and pedestrians. Based on the problems encountered in detecting objects by autonomous vehicles an effort has been made to demonstrate lane detection using OpenCV library. The reason and procedure for choosing grayscale instead of colour, detecting edges in an image, selecting region of interest, applying Hough Transform and choosing polar coordinates over Cartesian coordinates has been discussed.

General Filter Convolutional Neural Network (GFCNN) -

The results for this model GFCNN showed 30% less training time than that of CNN and the accuracy was higher compared to CNN despite the model being quicker.

Instead of letting Convolutional neural network choose its kernel, some predefined kernels used for image processing such as sharpening, edge-detecting, discrete cosine transformation and blurring were applied to the first layer of CNN.

Under the architecture, as the processing happens on each layer of convolutional neural network, the target area in the image becomes smaller.

The Canny Edge Detection Technique

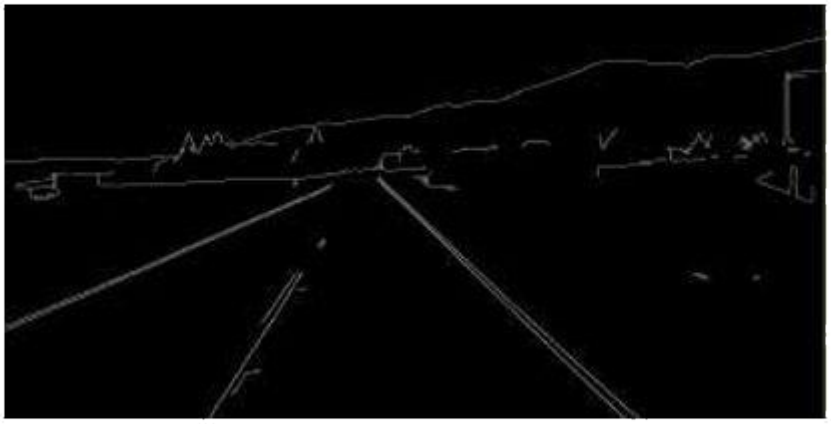
It identifies the boundaries of object in the image by detecting the sharp change in intensity. An image is an array of pixel and pixel store data about intensity ranging from 0 to 255. Gradient denotes the change in brightness in a series of pixels.

Gaussian blur

We have to smooth the image before processing it,it is done by modifying the value of the pixel by the average value of the pixel around it.

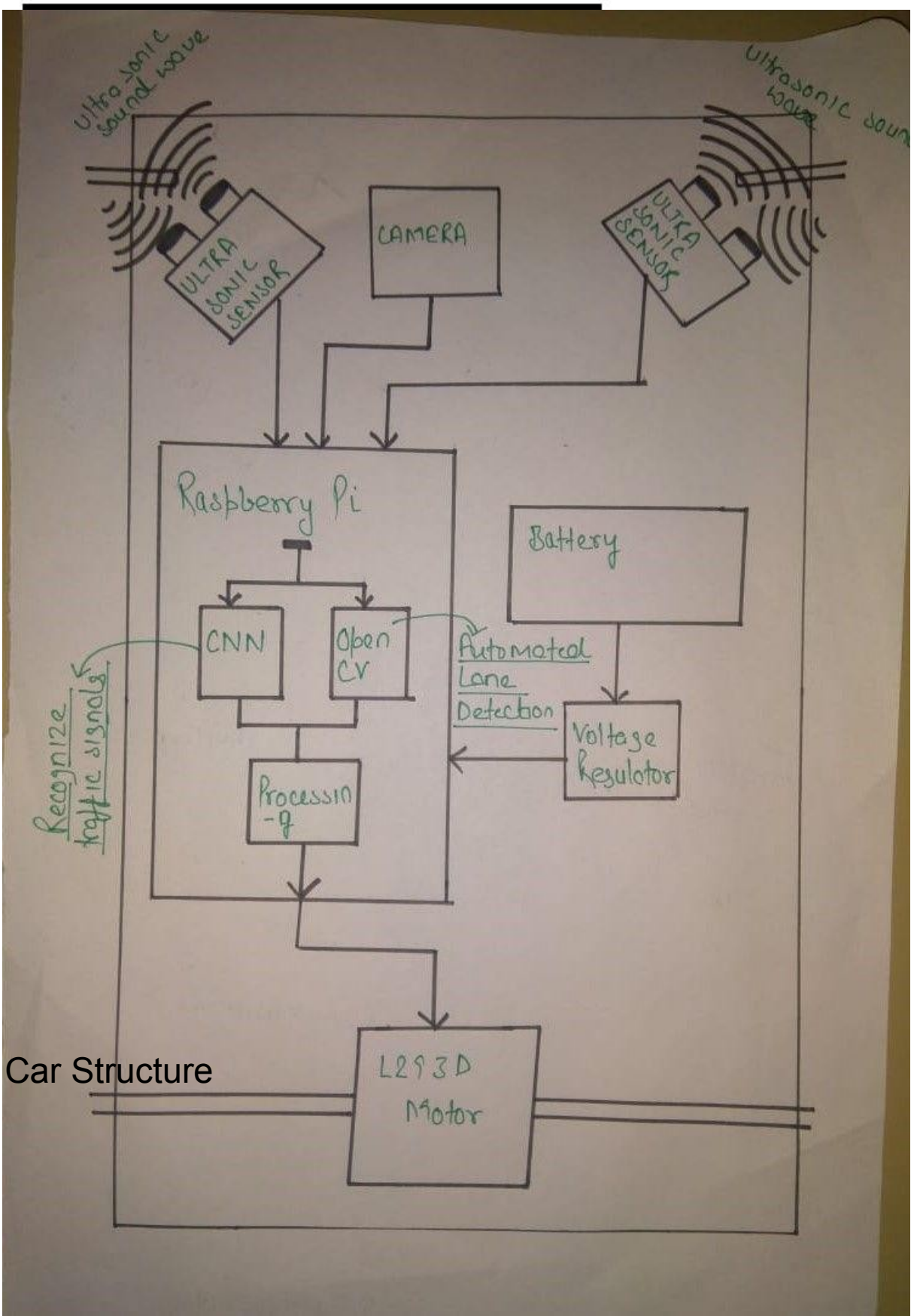
Edge detection

An edge corresponds to the region in an array where there is sharp change in the intensity or color between adjacent pixel.



Hough Transform

Now we make use of hough transform technique that will detect straight lines in the image and thus identify the lane lines



Car Structure

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dataset:-

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