Self Driving Car Using Image Processing

A PROJECT REPORT - Final Report

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1. Introduction

Self Driving car is an emerging technology that is gaining a lot of importance and is going to be a game changing innovation.Some pioneers in this field are Tesla, Apple, Uber and Google.They are building softwares for self driving car that use many sonar sensors along with cameras for image processing techniques to identify roads, other vehicles and pedestrians.

For this project we will be using a live video feed from iPhone camera to get the real time images.Next we will analyse and edit the image and pass it through a supervised learning algorithm for training.We will use IPCam to live feed the video to the laptop from where we will extract images at regular intervals.After obtaining the images we will perform various image processing techniques like resolution reduction, cropping, noise reduction, segmentation etc so that the image passed to the learning algorithm is efficient.We will also compare different procedures that can be applied on the image to improve performance like background reduction.We will provide a comparison on the various techniques used and determine the most efficient one. Beyond the scope of project we can try and implement passing car detection, pedestrian detection, lane changing, streetlight detection, cyclist detection.

Training:

A live feed from Iphone camera along with the corresponding RC remote control commands(Forward,Backward,Left,Right) in real time will be used to create a dataset of images as input and RC Commands as output.Further we will process the image for noise reduction, object detection, background reduction, pixel reduction.This dataset will be passed to a supervised learning algorithm like neural networks.

Testing:

A live video feed from the Iphone on top of RC Car will be passed to the already trained supervised learning algorithm after we have performed same image processing techniques on the live feed as we had done in Training.The output we get

form the neural network will be transmitted to the car via a the RC Remote Control connected to the laptop via an Arduino Uno.

Tools Required

Software:

1.)IPCam

2.)Matlab

3.)Arduino Uno

Hardware:

1.)RC Car

2.)Arduino

2.Theoretical Background

2.1 Image capture from car.

We use the Iphone places on top of the car to stream the live image using IPCAM technology.We send the live video over the LAN to the laptop.

CODE:

```
function ipcam_basics1()

NoOfIterations = 100;

se = strel('disk',8);

cam = ipcam('http://100.64.156.223:8081','username ','password');

for ctr = 1:NoOfIterations
```

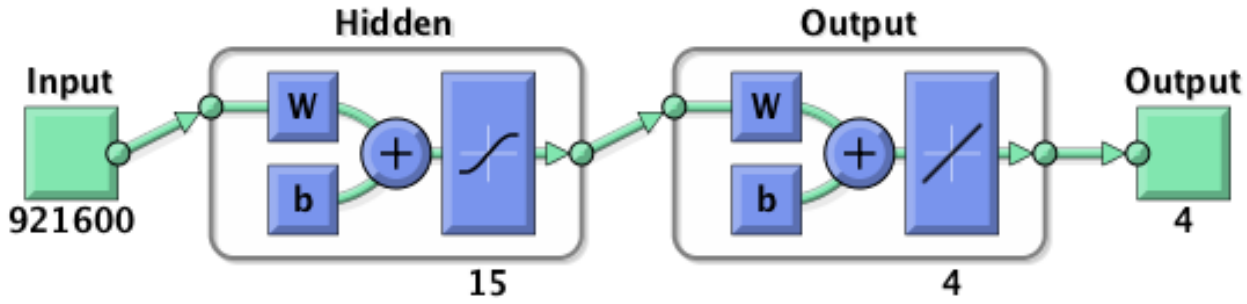
```
    img = snapshot(cam);

    results = myimfcn(img);

    closeBW = imclose(results.bw,se);

    imshow(closeBW);

    %fname = ['Image_Test' num2str(ctr)];

    %imwrite(img, fname, 'jpg');

    pause(0.2);

end

end
```

The result we get is a series of images taken at a regular interval.

2.2 General Model of Neural Network Training

Artificial neural networks (**ANNs**), a form of **connectionism**,[1] are computing systems inspired by the biological neural networks that constitute animal brain. Such systems learn (progressively improve performance) to do tasks by considering examples, generally without task-specific programming. For example, in image recognition, they might learn to identify images that contain cats by analyzing example images that have been manually labeled as "cat" or "no cat" and using the analytic results to identify cats in other images. They have found most use in applications difficult to express in a traditional computer algorithm using rule-based programming.

Here we use a fitting neural network with input as the pixels of the image and the output as the directions of movement.We use the ideal 15 hidden layers between the input and output to perform fitting.



Input is the 921600 pixel values

Output is the 4 binary values for forward, backward, right, left.

CODE:

% Solve an Input-Output Fitting problem with a Neural Network

% Script generated by Neural Fitting app

```
% Created 28-Aug-2017 23:04:33
%
% This script assumes these variables are defined:
%
%   A - input data.
%   B - target data.


x = A;
t = B;


% Choose a Training Function
% For a list of all training functions type: help nntrain
% 'trainlm' is usually fastest.
% 'trainbr' takes longer but may be better for challenging problems.
% 'trainscg' uses less memory. Suitable in low memory situations.
trainFcn = 'trainscg';  % Scaled conjugate gradient backpropagation.


% Create a Fitting Network
hiddenLayerSize = 15;
net = fitnet(hiddenLayerSize,trainFcn);
```

```
% Setup Division of Data for Training, Validation, Testing

net.divideParam.trainRatio = 70/100;

net.divideParam.valRatio = 15/100;

net.divideParam.testRatio = 15/100;


% Train the Network

[net,tr] = train(net,x,t);


% Test the Network

y = net(x);

e = gsubtract(t,y);

performance = perform(net,t,y)


%  fname = ['IMG_binarize5'];

%  img = imread(fname);

%  img = double(img(:));

%  y=net(img);


% View the Network

view(net)
```

```
% Plots

% Uncomment these lines to enable various plots.

figure, plotperform(tr)

figure, plottrainstate(tr)

figure, ploterrhist(e)

figure, plotregression(t,y)

figure, plotfit(net,x,t)
```

2.3 Image processing techniques.

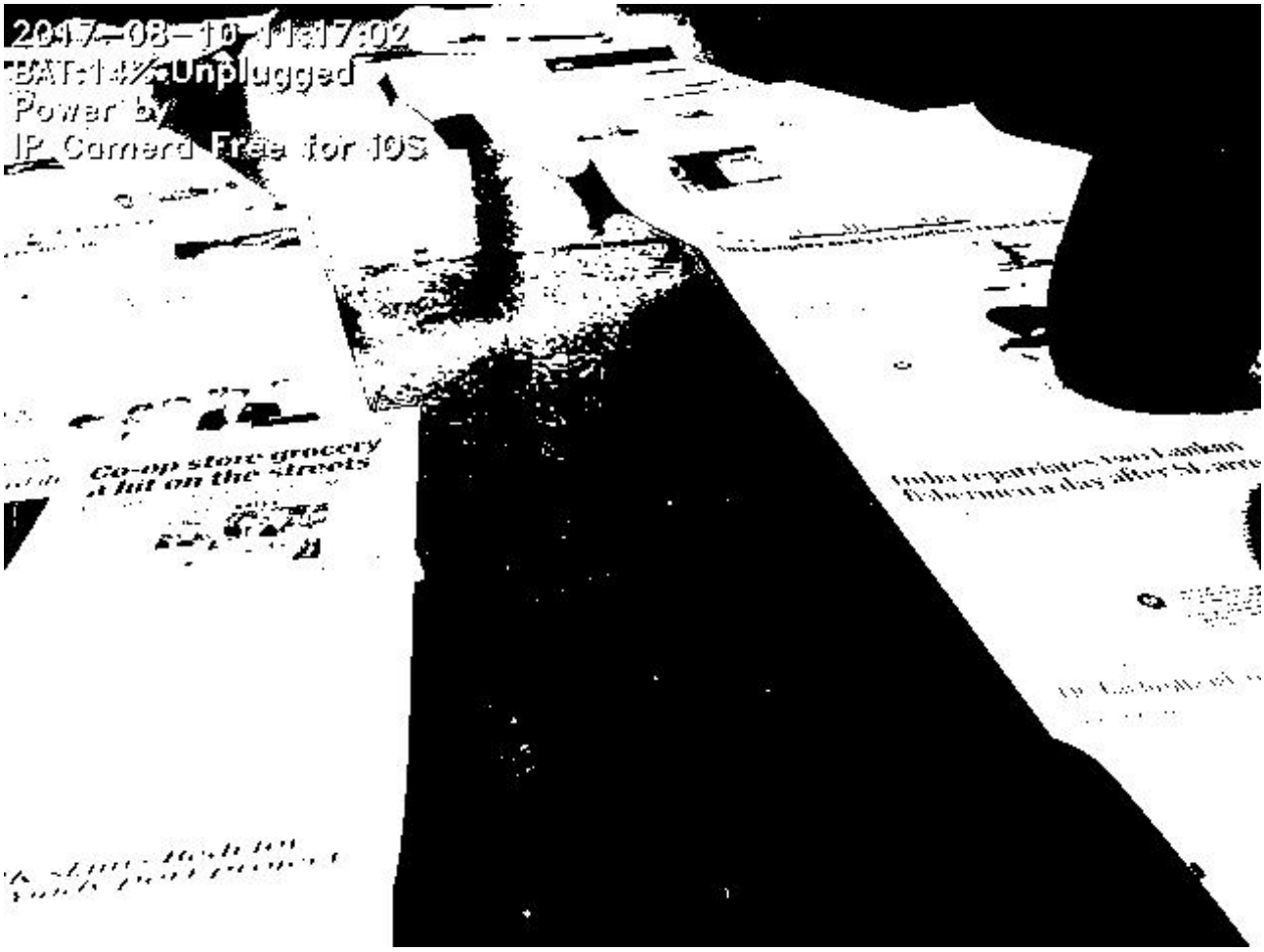
1.) First we perform coloured to binary scale

CODE:

```
function results = myimfcn(im)

%Image Processing Function

%

% IM      - Input image.

% RESULTS - A scalar structure with the processing results.

%



%-----------------------------------------------------------------------

% Auto-generated by imageBatchProcessor App.

%
```

```
% When used by the App, this function will be called for every input image
% file automatically. IM contains the input image as a matrix. RESULTS is a
% scalar structure containing the results of this processing function.
%
%------------------------------------------------------------------------




% Replace the sample below with your code---------------------------------

if(size(im,3)==3)
    % Convert RGB to grayscale
    imgray = rgb2gray(im);
else
    imgray = im;
end


bw = imbinarize(imgray);


results.imgray = imgray;
results.bw     = bw;
```

%----------


2017-08-10 11:17:02
BAT:14%-Unplugged
Power by
JP Camera Free for iOS
Co-op store grocery
A hit on the streets

2.) We perform washed segmentation.

This helps us segment the image into different segment.Here we can see that the image is segmented into three different segments where the yellow segment is the road.

3. Proposed Algorithm

Training

Get the image using IPCAM

Get the remote control directions using python script.

Perform required Image Processing on the image.

Feed the data to neural networks

Train the neural networks.

Testing

Get the required live streaming image using IPCAM

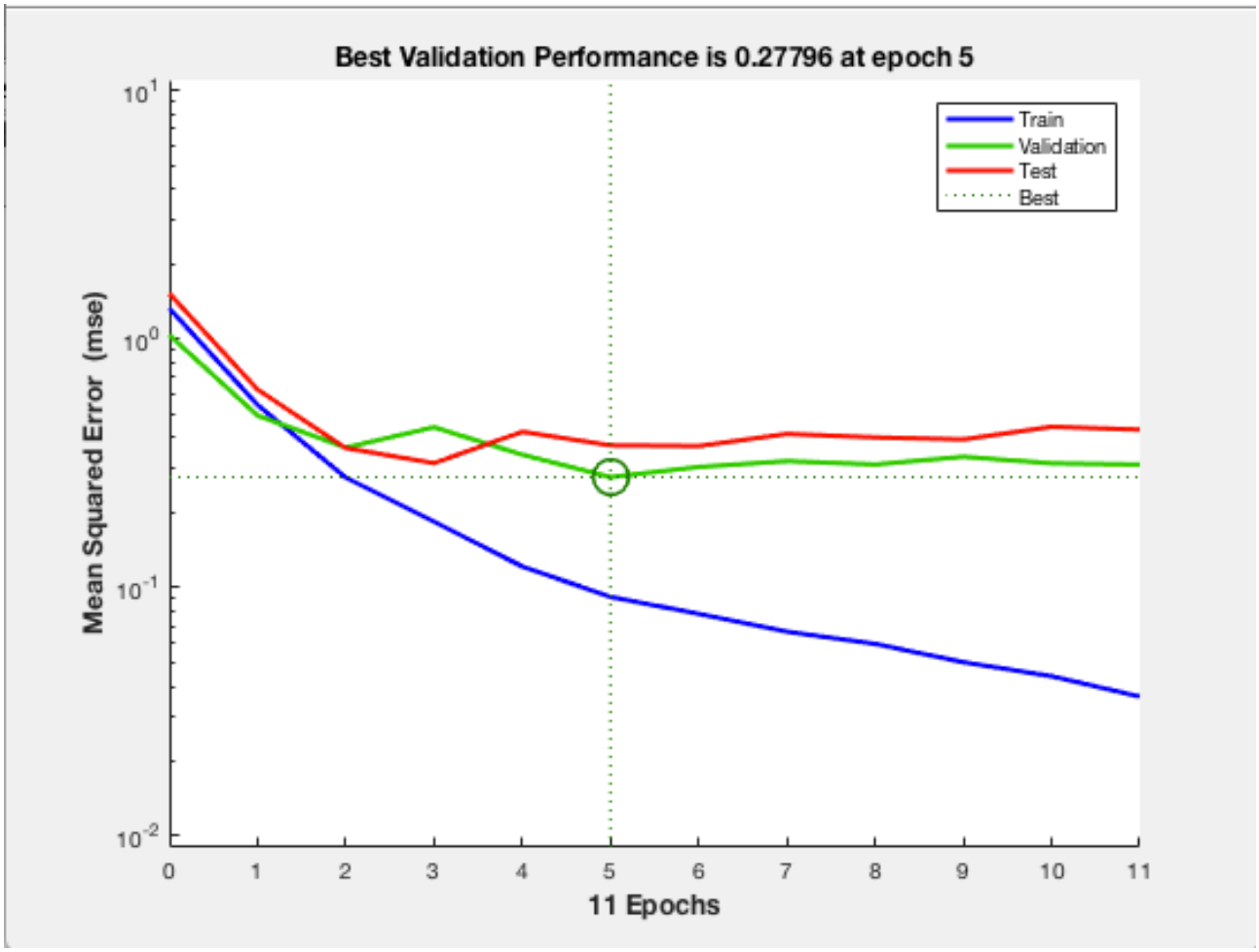
Feed it to the neural networks.

Neural networks outputs the 4 directions.

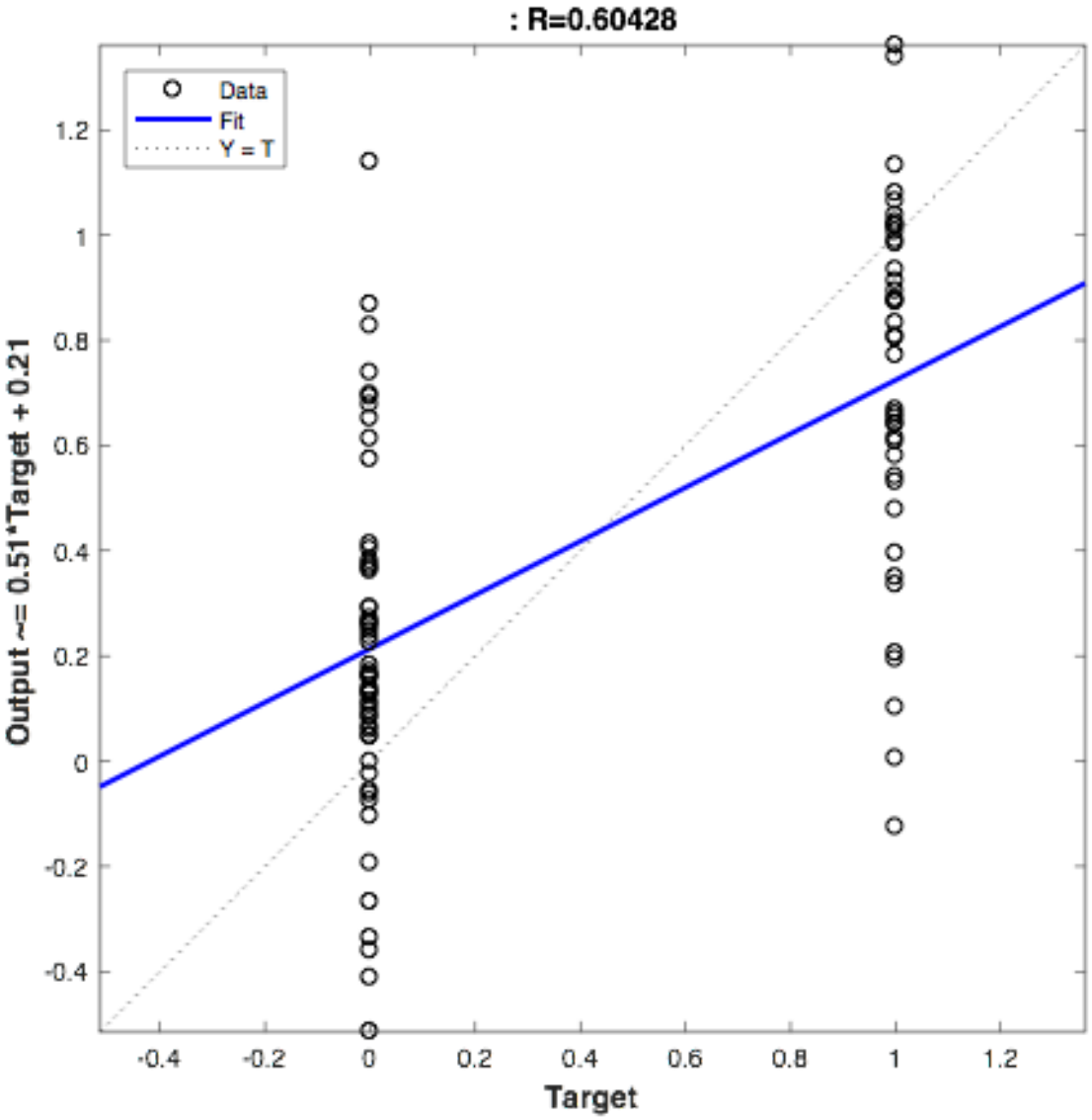
Use Matlab writeDigitalPin() function to send the message to car via transmitter.

4.Performance Analysis.

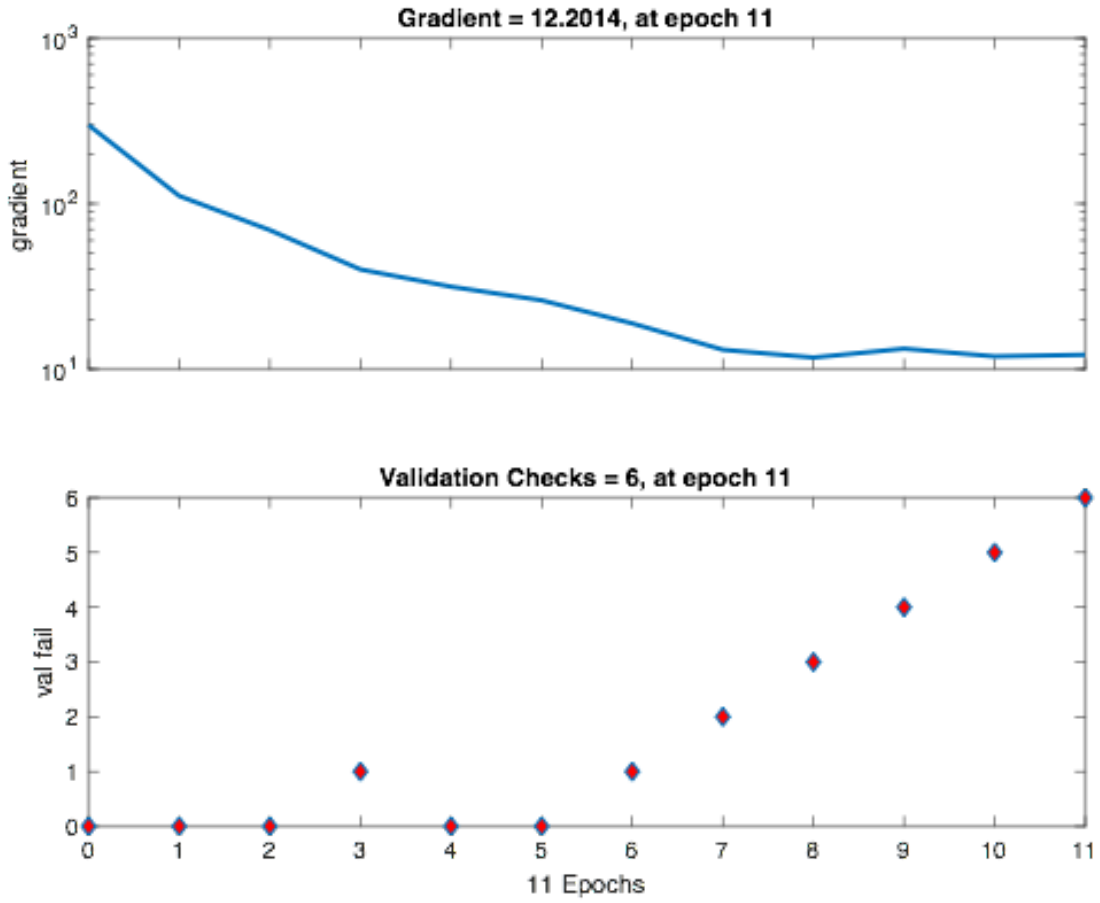
We get the performance of = 0.27796 at the epoch 5



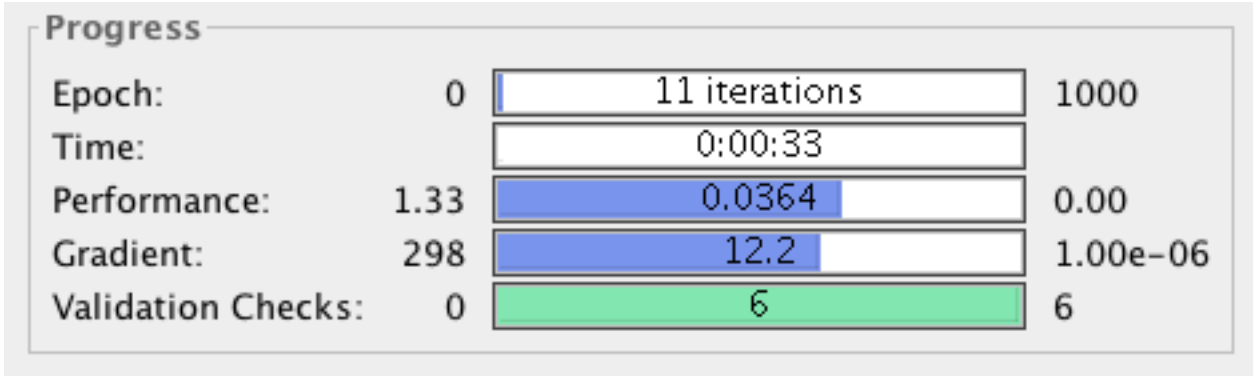
Plotting the regression graph with R=0.60428



Plotting the training state



Neural Network Training



5. Conclusion

As driverless cars enter the market, benefits to society's transportation system will soon emerge. Because computer systems have the capability to synchronize, lane sizes will be reduced to nearly the size of cars, while travel speed will increase (Frey, 2012). This will allow for more efficient flow of traffic, eliminating the frustration of gridlock and road congestion. According to Frey, highways "will be able to accommodate 10-20 times as many vehicles as they do today" .Other experts agree. Engineers M.L. Ho, P.T. Chan, and A.B. Rad,
experts in lane-change algorithm, share that "autonomous vehicles on automated highways are expected to enhance the safety and to improve the highway capacity".
Therefore, traffic conditions that once frustrated people will forever be eliminated, making transportation a
more relaxed, pleasant, and safe experience.

Eliminate the driver, and society will have safer, more efficient highways and fewer accidents. Take away the steering wheel, and automobile manufacturers will design vehicles to accommodate only the rider. Remove the brake and accelerator, and billions of dollars will be saved annually in fuel costs. Driverless technology is paving the way for society's future transportation system. Though it may seem impossible right now, technology never fails to amaze us. When considering companies are pouring billions of dollars into research and design, while petitioning governments for approval, it is only a matter of time when we discover driverless technology has conveniently arrived at our doorstep, ready to take us to any destination we choose

6. References

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https://en.wikipedia.org/wiki/Artificial_neural_network

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