Business Intelligence project

# Road accidents prediction in India

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# 1 Introduction

In today's world road and transport has become an integral part of every human being. Every body is a road user in one shape or the other.Road Transport is considered to be one of the most cost effective and preferred mode of transport, both for freight and passengers, keeping in view its level of penetration into populated areas.The typical road users include pedestrians, cyclists, motorists, vehicle passengers and passengers of on-road public transport. Road safety is a necessary measure that needs to be taken for the safety of all road users.

## 1.1 Problem Statement

Road transport is the dominant mode of transport in India, in terms of traffic share and in terms of contribution to the national economy.Road accidents in India are major source of deaths, injuries, fatalities every year . Therefore, its a major and growing health burden on Indian economy . Also, Traffic accidents cause physical, financial and mental effects for everyone involved.

## 1.2 Objective

- **Predict** the number of accidents in a time slot based on seven other time slots using linear regression and also predicting that how many accidents are possible in given time slot in given current year using past years' data.

- **Visualize** number of accidents for each state by year, change in percentage of accidents over the years, number of accidents for each state in different time slots,and number of accidents in day and night using various charts and plots.

- **Classify** the image of a road as whether the road have potholes or not(normal) using CNN.

## 2 Proposed Methodology

### 2.1 Dataset Description

We have used three datasets in the whole project. The first dataset's data was collected from Ministry of Road Transport and Highways, and was provided in kaggle. Table 3 is an example describing the dataset through counts of some key entities involved in the dataset.Every dataset also comprises of data attributes. Table 5 describes attributes of data. All the attributes in the dataset is unlabeled.

| **Details** | **Count** |
|---|---|
| Number of instances | 490 |
| Number of attribute | 11 |

**Table 1.** Details of the dataset.

The second dataset's data is collected from ITF(International Transport Forum ) Transport Statistics and was provided on OECD data.

| **Details** | **Count** |
|---|---|
| Number of instances | 722 |
| Number of attribute | 7 |

**Table 2.** Details of the dataset.

The third dataset contains two folders - normal and potholes. 'Normal' contains images of smooth roads from different angles and 'Potholes' contains images of roads with potholes in them.The images are collected form internet and was provided on kaggel.

| **Details** | **Count** |
|---|---|
| Number of images in potholes | 352 |
| Number of images in normal | 329 |

**Table 3.** Details of the dataset.

### 2.2 Attribute Description

The description of the first dataset's attributes are shown in table 4 .

| Data Attributes | Brief Explanation |
|---|---|
| STATE/UT | The state or union territory of India |
| YEAR | year of observation(2001-2014) |
| 0-3 hrs. (Night) | Number of accidents in this time slot |
| 3-6 hrs. (Night) | Number of accidents in this time slot |
| 6-9 hrs (Day) | Number of accidents in this time slot |
| 9-12 hrs (Day) | Number of accidents in this time slot |
| 12-15 hrs (Day) | Number of accidents in this time slot |
| 15-18 hrs (Day) | Number of accidents in this time slot |
| 18-21 hrs (Night) | Number of accidents in this time slot |
| 21-24 hrs (Night) | Number of accidents in this time slot |
| Total | Total number of accidents in that year |

**Table 4.** Details of Data Attributes.

The description of second dataset's attributes are shown in table 5 .There were total seven attributes in the dataset but only five are used in the project.

| Data Attributes | Brief Explanation |
|---|---|
| Location | The country where the accident occured |
| Indicator | Indicates the place of accident |
| Subject | Indicates the severity of the accident |
| Time | Indicates the year of accident |
| Value | Number of accidents per 1000000 individual |

**Table 5.** Details of Data Attributes.

The third dataset contains images with .jpg extension. There are two folders of images having more than 300 images the names of folders are "potholes" and "normal".

# 3 visualization

## 3.1 Time slot distribution

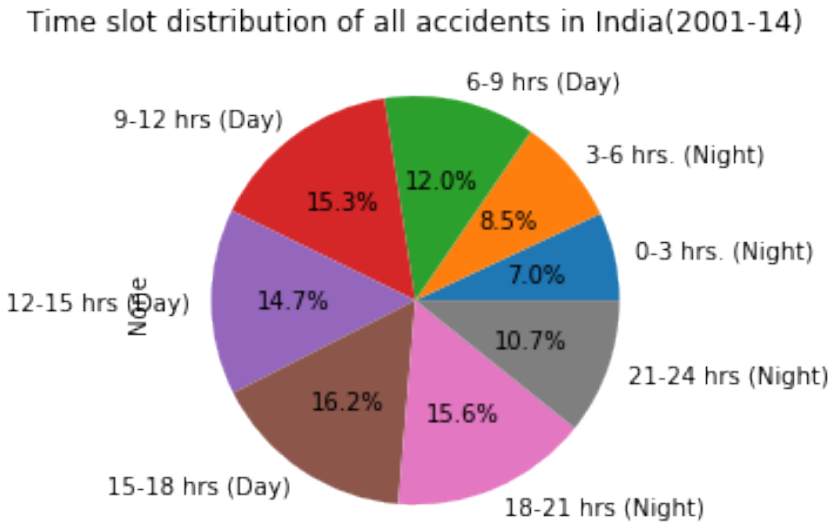



fig 3.1

fig 3.1 shows time slot distribution (hourly basis)for both day night using a pie chart. That is,the percentage of accidents based on hourly slot. maximum accidents occur during the day in between 15:00 and 18:00. minimum accidents occur during the night in between 00:00 and 03:00.

### 3.2 state wise analysis

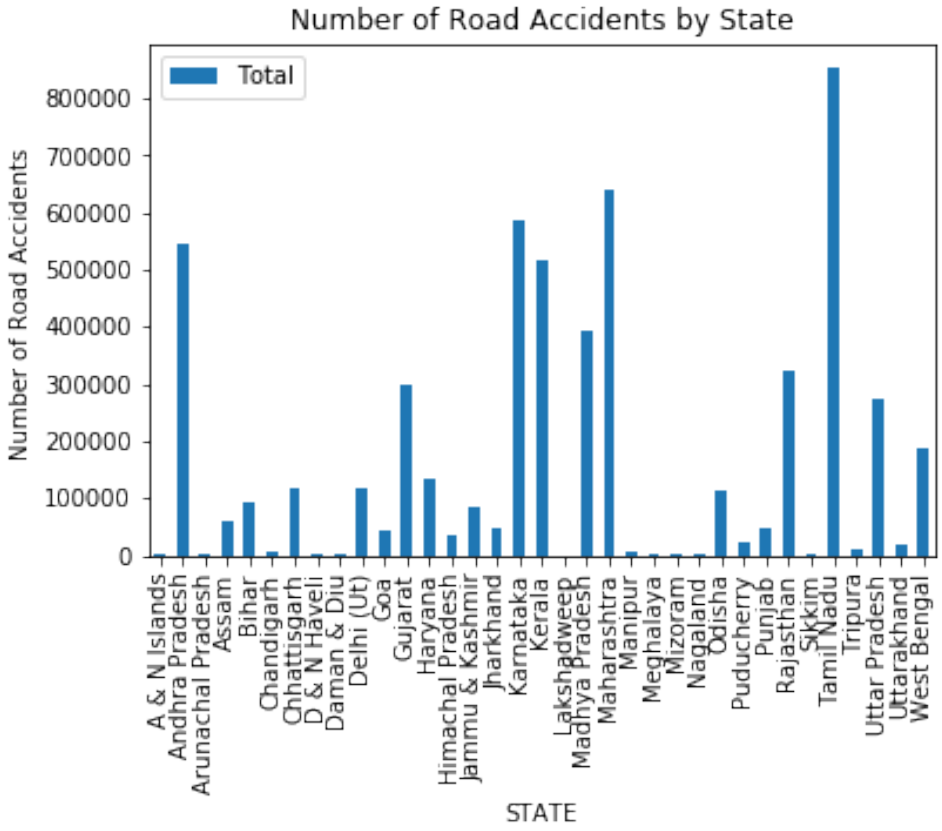



fig 3.2

fig 3.2 shows the bar graph between states on X-axis and number of road accidents on Y-axis. The number of accidents is the total number of accidents observed year wise. conclusion- the state with least number of accidents is The state with highest number of accidents is Tamil Nadu.

### 3.3 year wise analysis

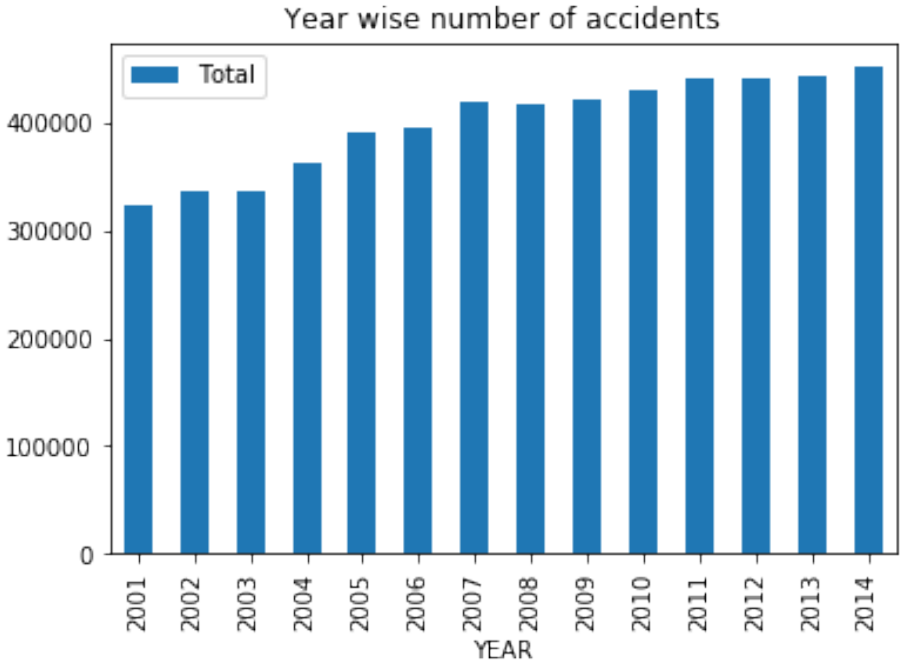



fig 3.3

fig 3.3 shows the bar graph between Year on X-axis and number of accidents on Y-axis. conclusion- least accidents in the year 2001 and highest number of accidents in the year 2014. we can clearly draw inference that number of accidents are increasing year by year.

### 3.4 top 5 states analysis

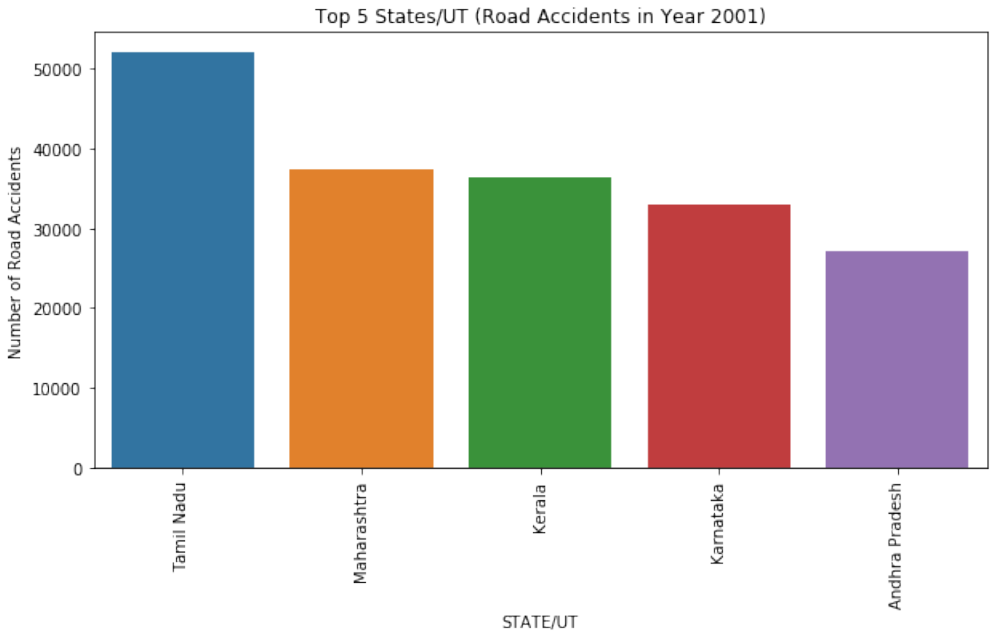



fig 3.4

Fig 3.4 shows the bar graph between top 5 states in terms of road accidents and number of road accidents happening on Y-axis. Tamil Nadu is the state with highest number of road accidents. Andhra Pradesh is the state with least number of road accidents among the top 5 states Also we can infer, all the 5 states are southern states of India. Hence, a higher risk in south indian states.

### 3.5 least 5 states analysis

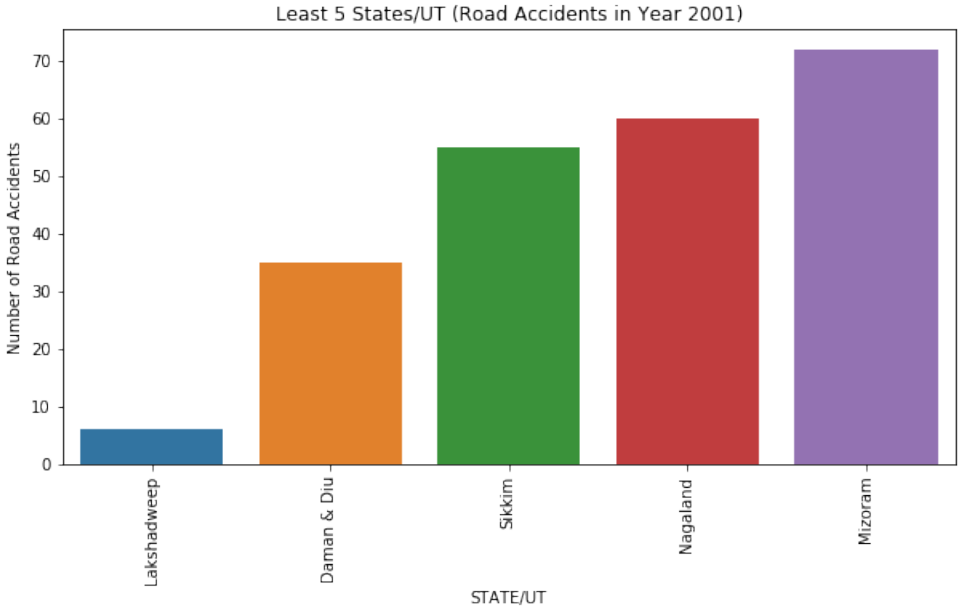



fig 3.5

fig 3.5 shows the bar graph between top 5 states/UTs with least number of accidents . Lakshadweep has least number of accidents. Mizoram has highest number of accidents among these. we can also infer that the north eastern states have least accidents among all.

### 3.6 union territory wise analysis

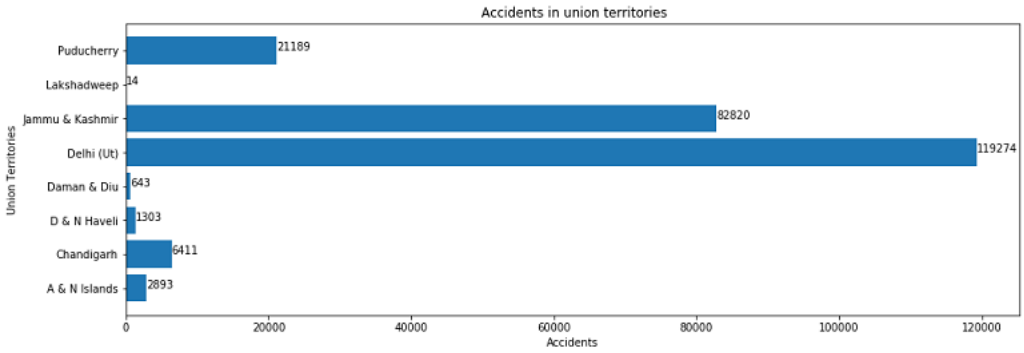



fig 3.6

fig 3.6 shows the bar graph between union territories on X-axis and number of accidents on Y-axis. Delhi has maximum number of accidents lakshadweep has least number of accidents.

### 3.7 region wise analysis

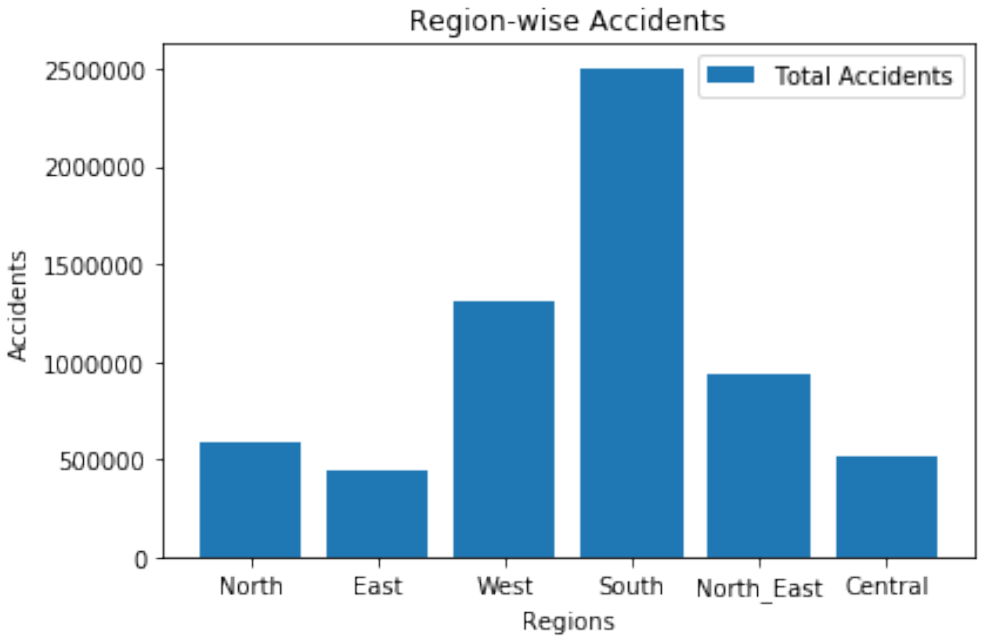



fig 3.7

fig 3.7 shows the bar graph between Regions of Indian state on X-axis and accidents on Y-axis. south India has the highest occurrence of accidents East India has the lowest occurrence of states.

### 3.8 time slot wise analysis

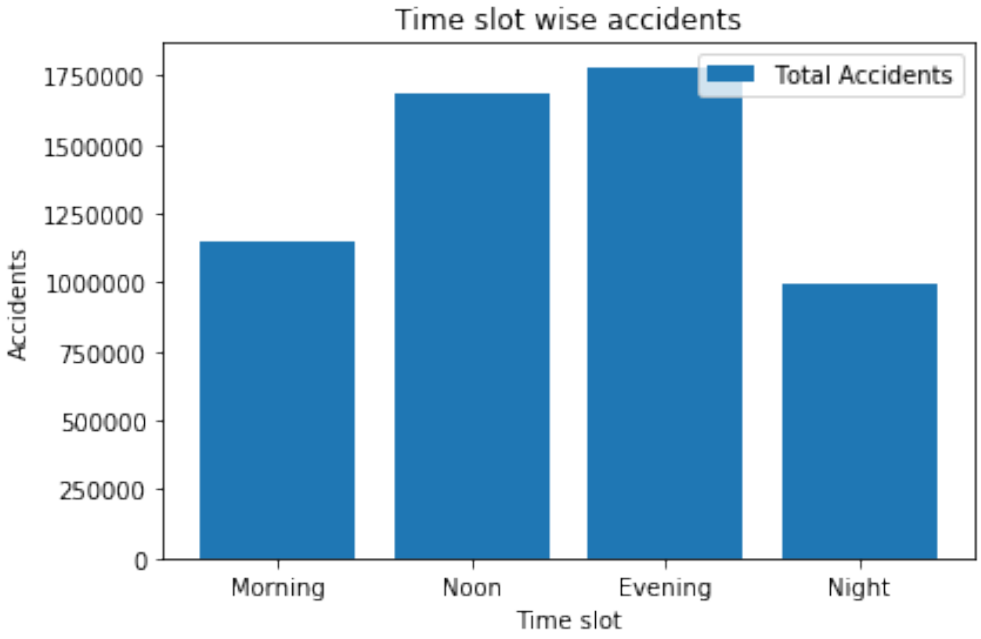



fig 3.8

fig 3.8 shows the bar graph between the time slot (morning, noon, evening, night) on X-axis and number of accidents on Y-axis. maximum accidents occur during evening time slot and minimum accidents occur at night.

### 3.9 Other Countries analysis

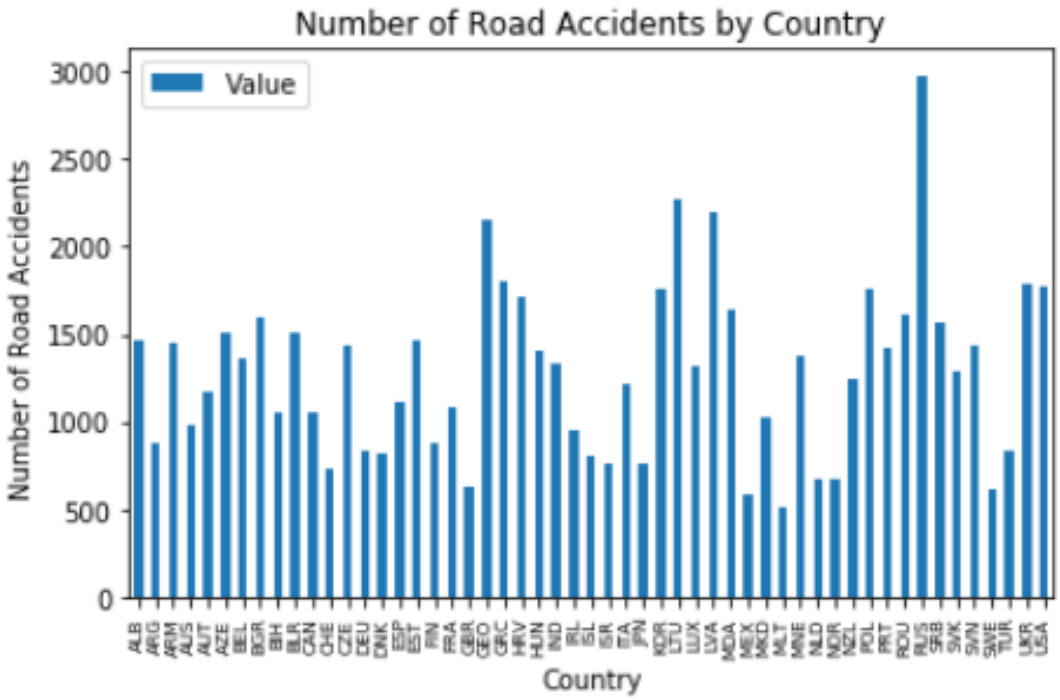



fig 3.9

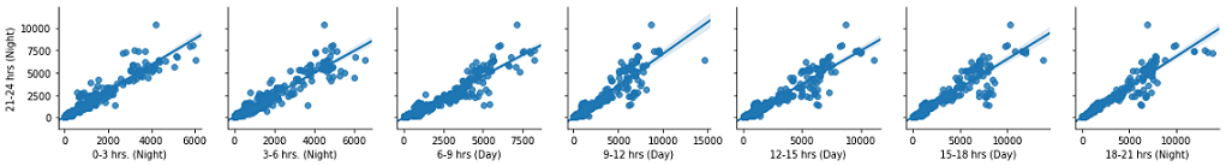
fig 3.9 shows the bar graph with number of road accidents on y-axis and name of country on the x-axis. By using this graph we can compare india with other countries in terms of Number of accidents.We can see that Malta has least number of accidents and Russia has highest number of accidents.

# 4 Algorithms

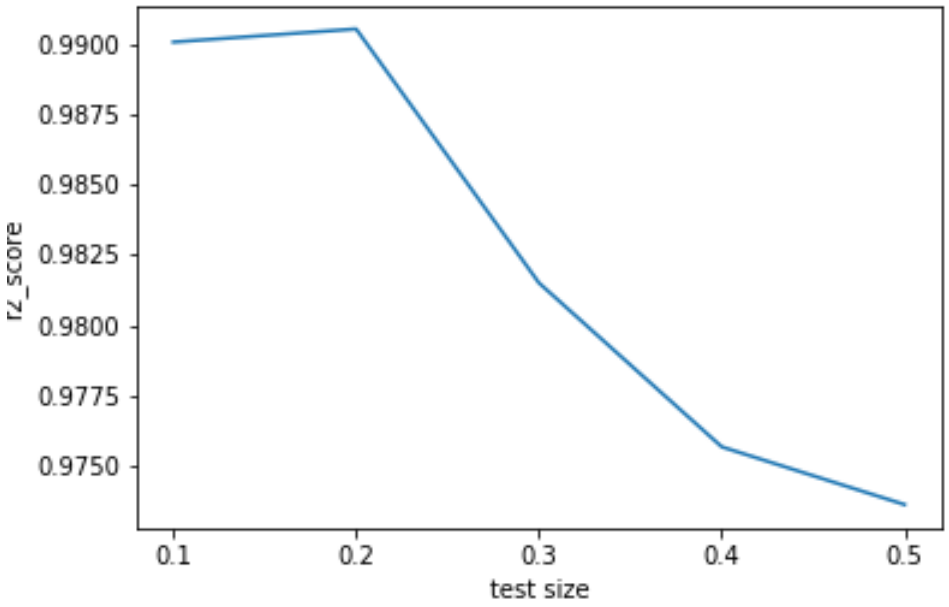
## 4.1 Linear Regression

**Description** Linear Regression is a machine learning algorithm based on supervised learning. It performs a regression task. Regression models a target prediction value based on independent variables. It is mostly used for finding out the relationship between variables and forecasting. Different regression models differ based on – the kind of relationship between dependent and independent variables, they are considering and the number of independent variables being used. Linear regression performs the task to predict a dependent variable value (y) based on a given independent variable (x). So, this regression technique finds out a linear relationship between x (input) and y(output). Hence, the name is Linear Regression. In the figure below, X (input) are the time slots from 0-21 hrs and Y (output) is the time slot 21-24 hrs. The regression line is the best fit line for our model.

**Graphical Representation** :




**conclusion** : coefficient of determination , that is, score is 0.9831726728479063
slope :
0.95377072 for 0-3 hrs(night)
-0.05388771 for 3-6 hrs(night)
-0.12513327 for 6-9 hrs(day)
-0.23734929 for 9-12 hrs(day)
0.09933494 for 12-15 hrs(day)
0.31747461 for 15-18 hrs(day)
0.20402073 for 18-21 hrs(night)
intercept is -3.5794359619339957



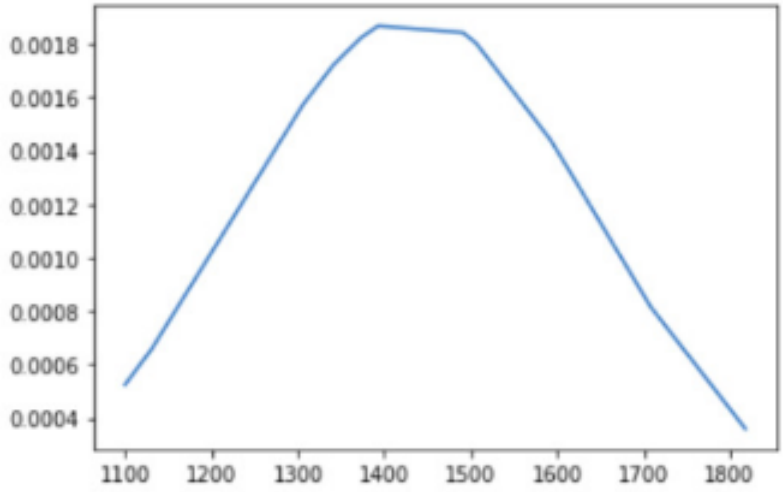

**conclusion** : r2 score falls as test size increases

### 4.2 Gaussian Distribution

**Description** The normal distribution is also called the Gaussian distribution or the bell curve distribution.
Continuous probability distributions are encountered in machine learning, most notably in the distribution of numerical input and output variables for models and in the distribution of errors made by models. Knowledge of the normal continuous probability distribution is also required more generally in the density and parameter estimation performed by many machine learning models. continuous probability distributions play an important role in applied machine learning and there are a few distributions that a practitioner must know about.
The distribution covers the probability of real-valued events from many different problem domains, making it a common and well-known distribution.
The distribution can be defined using two parameters:
Mean (mu): The expected value.
Variance (sigma*sigma): The spread from mean.
Standard Deviation (sigma): The average spread from the mean.
A distribution with a mean of zero and a standard deviation of 1 is called a standard normal distribution, and often data is reduced or “standardized” to

this for analysis for ease of interpretation and comparison.
By using Gaussian distribution we have predicted the number of accidents which can take place in a given state of India at a given time in the year 2015.In the below shown graph we have shown the probability distribution and given state "Delhi (UT)" and time "18-21 hrs (night)" as input and bell shaped graph is obtained.

**Graphical Representation** :




**Conclusion** The Number of average accident which can occur in 18-21 hrs in 2015 are 1436.

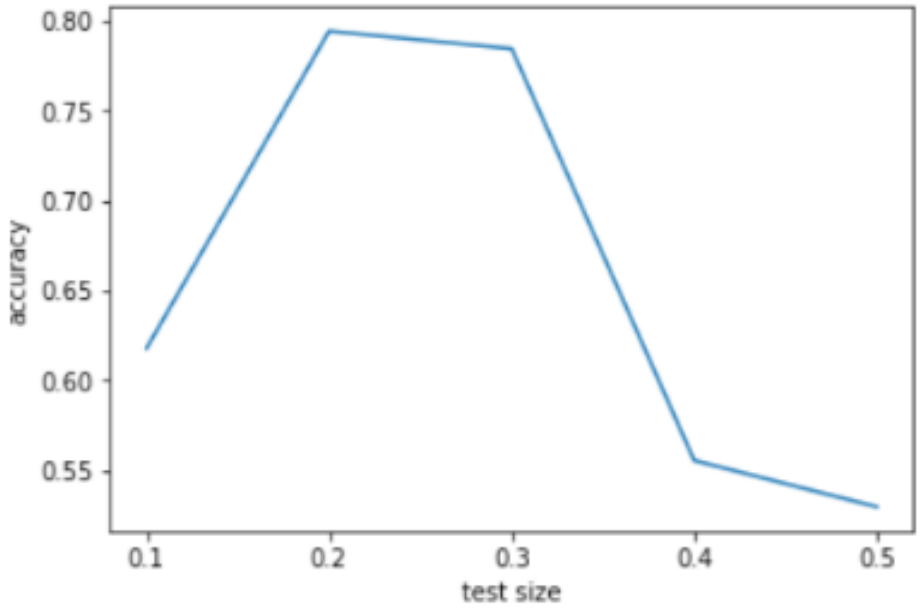
### 4.3 Convolutional neural network

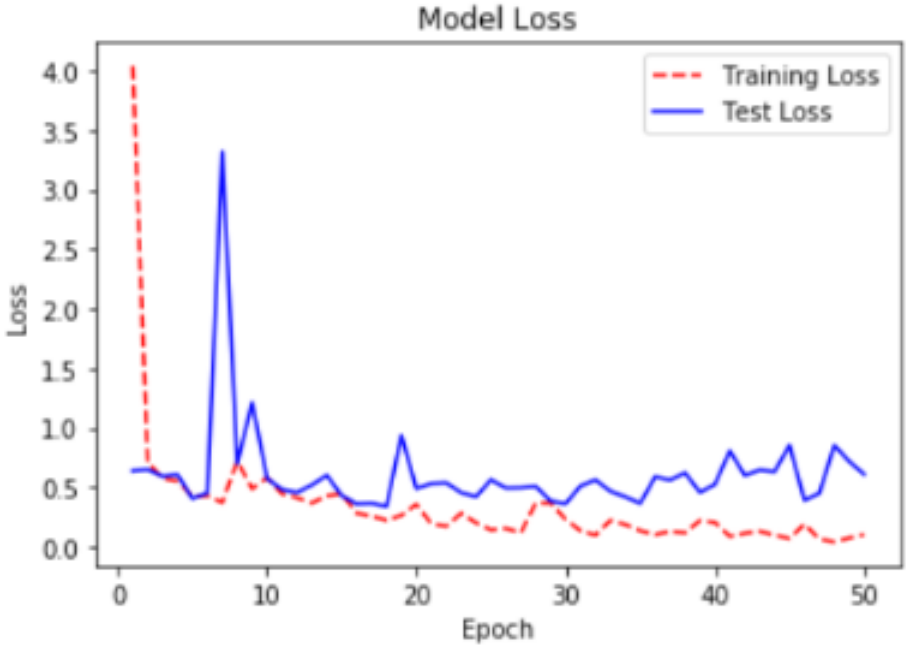
**Description** Convolutional Neural Network (CNN) is a type of Artificial Neural Network used in image recognition and classification. It basically has four layers – Convolutional layer, ReLU layer, pooling and fully connected layer.
The architecture of the CNN model is discussed below-
1) We developed a sequential model, where layers are connected sequentially to each other.
2) Input is passed to a series of convolution layers and ReLU activations. These layers help in the extraction of certain features from the image. We used ReLU layer to remove all the negative values that we got from the output of convolutional layer.
3) Each convolution layer is followed by a max pooling layer which helps in reducing the dimension of input further.
4) Then we used Flatten layer this is the final layer where actual classification takes place.so here we take our filtered and shrink images and we put them into

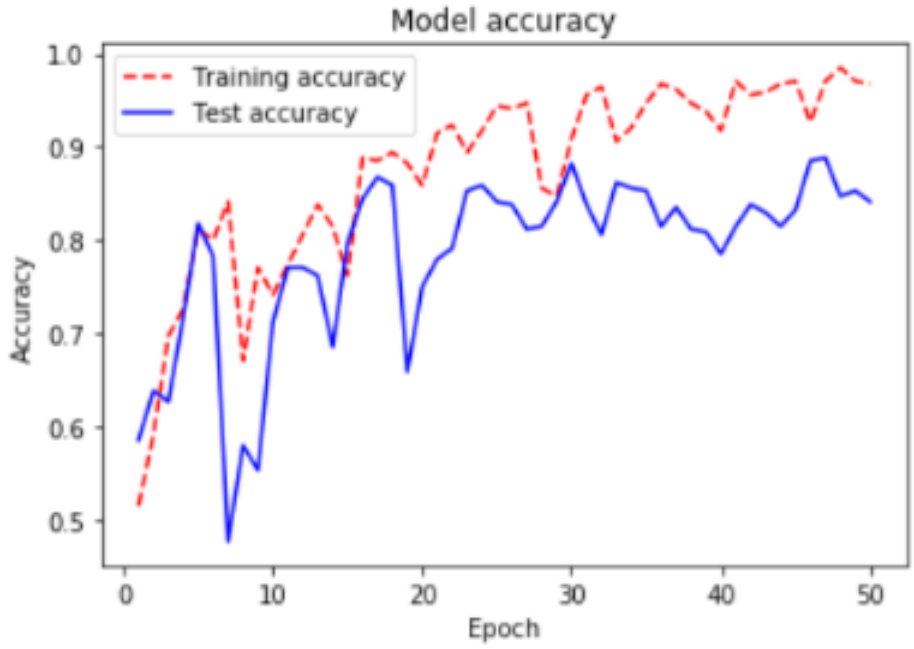
a single list.
5) Then we used Dropout for randomly discarding the neurons to avoid overfitting.
6) Finally, the output of the previous layer enters as an input to the dense layer with one neuron that finally classifies the input as 0 or 1.
7) The model uses categorical cross-entropy as the loss function which is a logarithmic loss function.
8) Adam optimizer with various parameters like learning rate has been used for optimization.

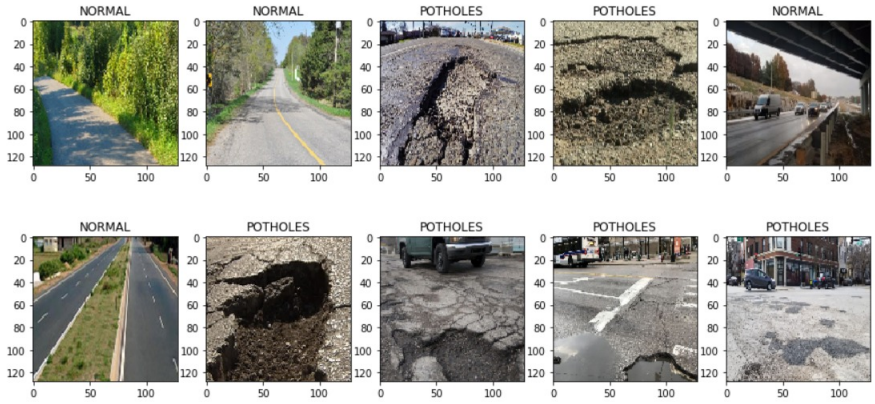
The parameters taken during the experiment are given below –
- Train-test split: 75:25
- Image size: 128*128
- Total categories:2
- Total images:681
- Number of epochs:50
- Batch size:12
- Learning rate:0.001
- Activation: ReLU for convolutional layer, softmax for Dense layer
- Loss function: categorical cross entropy.

**Graphical Representation** :




Model Loss
Training Loss
Test Loss
Loss
Epoch
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50


Model accuracy
Training accuracy
Test accuracy
Accuracy
Epoch
1.0
0.9
0.8
0.7
0.6
0.5
0
10
20
30
40
50




**Conclusion** From this experiment, we have sucessfully classified the images and achieved an average training accuracy of 96.76 percent and average validation accuracy of 84.12 percent.

## References

1. https://machinelearningmastery.com/continuous-probability-distributions-for-machine-learning/
2. https://data.oecd.org/transport/road-accidents.htm
3. Dataset is taken from, https://www.kaggle.com/vikasds101/road-accident-state-time

[1] [3] [2]