

# ROAD SAFETY ANALYSIS BASED ON VEHICLE VIBRATION AND SOUND USING DEEP LEARNING TECHNIQUE

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**College** : *Sahyadri College of Engineering & Management, Mangaluru-575007*  
**Branch** : *Department of Information Science and Engineering*  
**Guide(s)** : *Prof. Rithesh Pakkala P*  
**Student(S)** : *Mr. Suhan Acharya*  
*Mr. Abhishek Mallya*  
*Mr. N Rahul Rao*  
*Mr. Swasthik Shetty*

## **Keywords:**

CNN, Deep learning, BLSTM, Labels, Road safety

## **Introduction**

Government officials observed that 3,564 accidents happened in 2020 as a result of potholes. The surfaces/smooth roads are constantly under high traffic and the weather conditions also affect the road quality due to factors like rain, heat. This causes traffic delays and reduces road safety. The deformations due to this leads to formation of potholes and cracks which are a threat to vehicles. We intend to build a model to identify and annotate the road conditions using sound data from the vehicle engine/gearbox system recorded with a smartphone mic using deep learning technique. The application will provide the user with the map interface that will show the user the current road condition which will help the user decide on whether he wants to travel on that particular road. The map will also show the areas of the road where a particular event (i.e pothole, bumps etc.) will be shown.

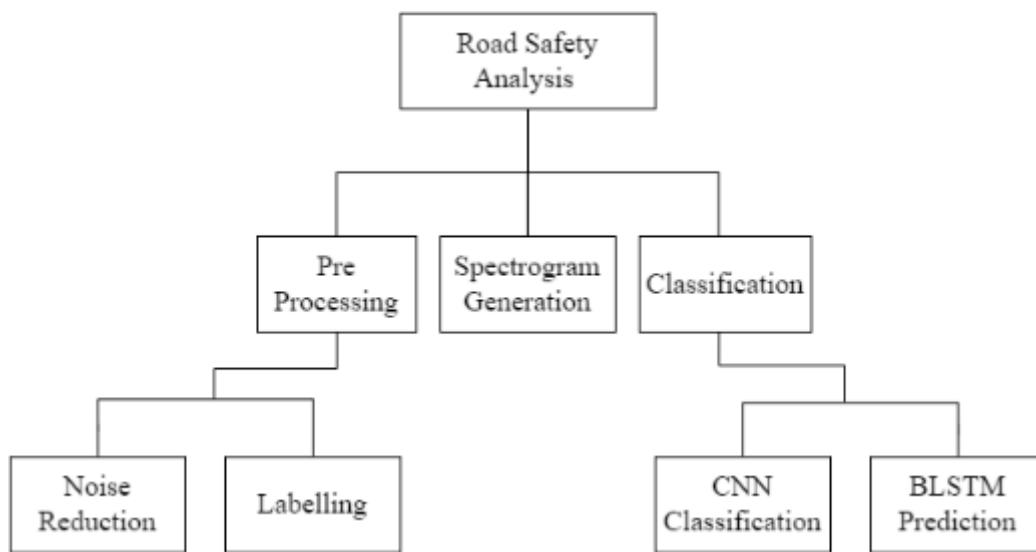
## **Objective**

- (a) To develop a data collection tool for manual labeling of recorded sounds.
- (b) To identify the sound signatures generated by Spectrograph of the sound waves.
- (c) To visualize annotated zones on a simple map user interface.
- (d) To automatically notify the road condition to the respected authority.
- (e) To analyze the curvature of the roads using the sound signatures.

## **Methodology**

The application is built in order to provide a map interface to the users which warns them of any particular events (ie. potholes, bumps etc.) in the road which is helpful to the users in case they are traveling on a path that is not known to the user.

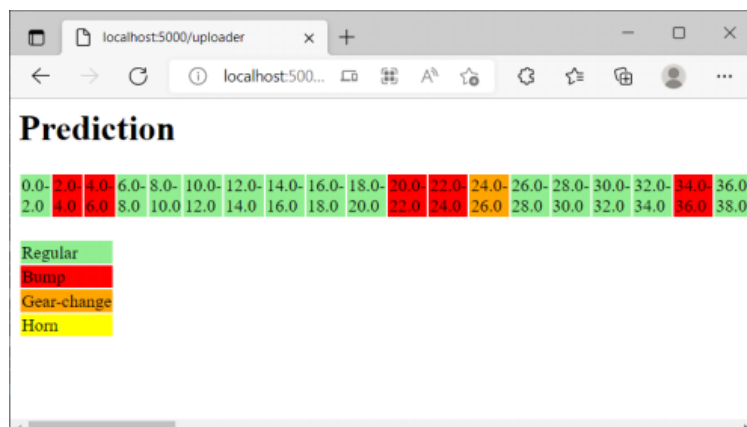
A smart phone device has multiple sensors in them and the application uses the audio and location of the device to record the vibrations of the engine/gearbox (i.e pothole, bumps etc.) and track the location to show it in the map interface. In the training phase the recorded audio is sent into a pre-processing phase where the noise is reduced and then the audio is labeled manually at any particular event. The audio after labeling is converted into a spectrograph which gives a graphical representation of the particular event. This spectrograph is segmented and CNN algorithm is applied on each segment to train the model. Once the training is done, the model should be able to generate spectrographs for each segment and identify the events automatically and label any particular event. After the labeling process the event with the timestamp and respective coordinates is sent to the front-end to integrate it with the map interface



Modular Diagram of Road Safety Analysis

## Result and Conclusion

This project is aimed at providing users with optimal path choices by avoiding potholes. The user gets a map output with annotated routes of which routes are most feasible. The respective authorities can take note of the routes and take action whenever necessary. The final UI would look like the image below which has a start button to start recording sound data along with location.



```
Splitting audio...
./data/audio/segments/scen-kpt-sample/scen-kpt-sample_0.0-2.0.mp3 was
created!
./data/audio/segments/scen-kpt-sample/scen-kpt-sample_2.0-4.0.mp3 was
created!
./data/audio/segments/scen-kpt-sample/scen-kpt-sample_4.0-6.0.mp3 was
created!
./data/audio/segments/scen-kpt-sample/scen-kpt-sample_6.0-8.0.mp3 was
created!
```

```
./data/prod/spectrogram/segments/scen-kpt-sample/scen-kpt-sample_10.0
-12.0.png created!
./data/prod/spectrogram/segments/scen-kpt-sample/scen-kpt-sample_100.
0-102.0.png created!
./data/prod/spectrogram/segments/scen-kpt-sample/scen-kpt-sample_102.
0-104.0.png created!
./data/prod/spectrogram/segments/scen-kpt-sample/scen-kpt-sample_104.
0-106.0.png created!
```

```
0.0-2.0 regular
2.0-4.0 bump
4.0-6.0 bump
6.0-8.0 regular
8.0-10.0 regular
10.0-12.0 regular
12.0-14.0 regular
14.0-16.0 regular
16.0-18.0 regular
18.0-20.0 regular
```

## Scope for future work

Modules attached to buses travelling on a particular route regularly in a day for better understanding of the path. Better and larger datasets for more accuracy. Betterment of algorithms used in the project.