**Identification of emergency vehicles using Deep learning Audio classification**

**Overview:**

As we know that any object that vibrates, produces sound waves. in my project I wanted to show the difference between the sound waves produced by an emergency vehicles like ambulance and the sound waves produced by a non-emergency vehicle like a car. The objective of this project is to create a deep learning algorithm which can detect concrete sounds of emergency and non-emergency vehicles. Usually, the traffic signal cannot detect the presence of emergency vehicles so, I wanted work on a deep learning model which helps in detecting the emergency vehicles. Create an automatic emergency vehicle detection system that detects emergency vehicles at a sufficient distance and changes the traffic lights accordingly. We have learned only about image classification in our class so I wanted to work on a model where we can detect audio signals using time domain series and spectrogram.

**Problem statemen:**

A delay in receiving medical care causes approximately 24000 deaths daily, according to the national crime records office. Any accident victim must wait for assistance at the scene, and every second they take to get there costs them their life. Being caught in a traffic jam is one of the main causes of this delay. By creating an automatic model that detects the emergency vehicles from a certain distance we can minimize this problem. This model not only helps to detect the emergency vehicles but also helps in changing the traffic signal lights accordingly so that there isn’t much traffic and can provide way for the emergency vehicles.

**Audio signals classification using**

1. **Using Time Domain**

Creating a model which can differentiate the sounds created by an emergency vehicle such as siren sound from the sounds that come from normal vehicles.

To create such model, we used Time domain and Spectrogram. A Time Domain model refers to a physical signals or time series of environmental data with respect to time. It depicts the amplitude of the sound produced by each vehicle at different time intervals. We are creating a 2-D plot using amplitude and time of the sound waves representing time on X-axis and amplitude on Y-axis.

1. **Using Spectrogram**

Coming to Spectrogram. It is a 2-D lot cleated using time and frequency as the attributes. A spectrogram is used when we classify the audio signals were spectrum of frequencies are recorded at particular time.

**Techniques Used**

The techniques used are CNN and LSTM.

* First, I used CNN on a Time Domain model and tested the accuracy of the model. Then used LSTM. Compared the accuracy of both models.
* Second, created two spectrogram model using both CNN and LSTM and noted the accuracy rate. After running the model, the accuracy with the spectrogram model was seen to be higher than the Time domain models. The accuracy of the CNN model was over 97

**Conclusions**

After studying and understanding the theory of audio classification and audio data we concluded that the audio data collected using Time domain and spectrogram play a critical role in determining the model challenges and building a model. The challenges that I faced was understanding how the audio data can be collected and differentiated from the siren sounds and non-emergency vehicle sounds, breaking the audio to use them on both time domain and spectrogram models.

**Contributions:**

* In our course we learned about image classification and the techniques that are used for understanding image classification.
* Learned how to build a model to determine image classification using CNN and LSTM.
* In studied and worked on a previously built model that is used in Audio classification. Using the techniques that I previously mentioned. Which are LSTM and CNN.
* Used Time Domain and Spectrogram. Including LSTM and CNN in both compared the accuracy of the models.

**Appendix**

Link to My code: <https://github.com/VJYRDY/64061_valmalac/blob/main/Emergency_vs_Non_Emergency_Vehicle_Sound_Classification.ipynb>