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# Classification of Traffic Density using Three Class Neural Network Classifiers

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***Abstract* - In this project we will estimate the vehicular traffic density by using three class neural network classifiers. We will estimate three probable conditions of traffic that is heavy flow \, medium flow and low flow (free flow).We will use non contemporaneous recording and scarcity of data for training and testing the performance of recognition task. Two conclusions can be drawn from the results, the first, MFCC has better performance with long recording, LPC residual has better performance with short recording.**

**Adaptive classifiers are used to model the traffic density state as low, medium and heavy. For the developing geographic the where the traffic is non-lane driver and other technique (magnetic loop detector) are inapplicable. The hardware part consists of the autocorrelation core that solves the part of the algorithm with higher computational costs. The software part consists of managing the windowing block. The implementation results are presented, a comparison is then made among the three architectures with the performance.**

***Keywords—Linear Predictive Coding(LPC);Mel-Frequency Cepstral Coefficients(MFCC);classifiers.***

## 1. INTRODUCTION

Now -a- days, density of traffic on roads and highways has been increasing constantly due to motorization, urbanization and population growth. Usually traffic congestion reduces the efficiency of transportation infrastructure of a city. As a number of vehicles are constantly increasing, it become necessary to facilitate effective control of traffic flows in urban areas. Especially in rush, however if there is a poor control at traffic signals. It may result in long time traffic jam causing delays in traffic flows.

In developed countries Intelligent Transportation System (ITS) plays a vital role for traffic congestion where traffic flows should be orderly and lane driven. For this purposes use of multiple sensors such as magnetic loop detectors, speed guns and video camera were used. But the cost of installation and maintenance is very high. Therefore over the past decade, researchers have been developing several non-intrusive. In such situation, road signal seems to be a good approach for traffic monitoring due to its inherent row cost of installation and operation. Therefore, several researcher have been developed various traffic monitoring techniques based on audio modality.

## 2. MOTIVATION

The causes that motivated this research are discussed in this section. The WHO disclose that, nearly 3,400 people get injured in accident every day. The intense social and economical impacts of road accidents have motivated the research towards SVM. The SVM will enhance driver safety and reduce traffic deaths and injuries by implementing collision avoidance, warning systems and classifying the traffic density.

The safety for driver application the vehicular communications have stringent reliability and delay requirements, which are not satisfied by current wireless standards. As a result to enable communication in the vehicular environment, the SVM with set of neural network are provided. Traffic monitoring systems developed so far are primarily focused on structured traffic that is not the case in country like India. Development of overhead structures can't be considered as a viable option since it is increased the cost, the same goes under the road construction. Classify to analyze traffic pattern , near real time reporting and simultaneous conduction of smooth traffic flow.

## 3. PROBLEM DEFINITION

Now-a-days the researchers are so much interested in automatic real time traffic congestion estimation tool. Many researchers have focused in their work on traffic flow estimation. They refer to use spot sensors, like loop detectors and sensors to quantify the traffic flow [4]. However, the cost of sensors is very high and expensive and need a lot of maintenance especially in developing countries like Egypt bead ground deformations. It was observe that the traffic congestion also occurred while using the electronic sensors for controlling the traffic. In contrast, the acoustic signal systems are much better compared to all other techniques.

The problem with traffic density measurement is the traffic density road with stationary or unwanted vehicles is the same as the traffic density of road with no stationary vehicles. Therefore, it can be considered as a combination of both traffic density and traffic flow.

## 4. LITERATURE REVIEW

The project creates a graph of traffic density in a minute, in an hour, etc. Accordingly, a graph is charted to help determine the variations in traffic. It focuses on increasing the transport efficiency without any additional infrastructure. It also proposes a traffic control by assessing the density of the real-time traffic.

The traffic will be capable of adjusting both the sequence and length of the traffic in accordance with the real time traffic. Though the system will provide higher throughput and lower average waiting time of vehicles, in the absence of a fixed sequence, chances of system errors and confused drivers

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cannot be overlooked. Similar to the Density Based Traffic Control System is the Intelligent Cross Road Traffic Management System proposed which focuses on not only relieving blocked roads, but also help emergency vehicles find their way to their respective destination. Though it is a very practical method, the overhead of the processor is quite high, considering the task of calculating the number of vehicles on each side of the road.

The Intelligent Traffic Density Control reduces the number of vehicles waiting for their chance to move out. The system gives equal preferences to all the vehicles plying, ignoring all the emergency vehicles

## 5. PROPOSED METHODOLOGY

It comprises of three stages namely, data collection, feature extraction and Classification.

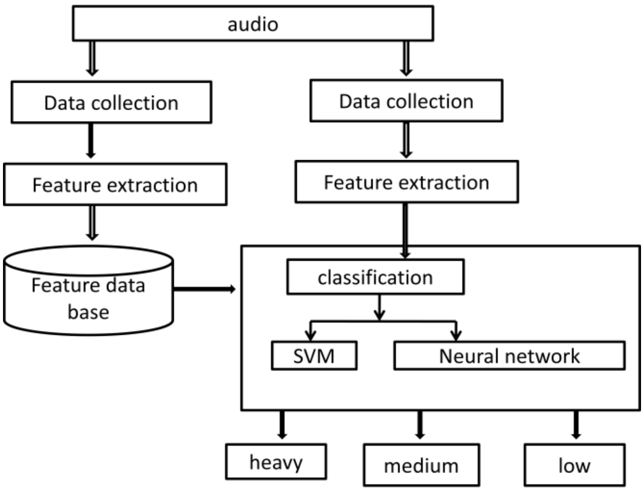


Figure No. Block Diagram of the Proposed Methodology

1) We will use cumulative acoustic signal which can be used to estimate the traffic density as free flow, medium flow, and heavy flow.
2) In order to get the more accuracy we will use Support Vector Machine (SVM) and Neural Network Classifier.
3) In this project, first we acquire 25 input samples of acoustic signal of each traffic condition. Each sample is of 60 sec long.
4) After that we will extract feature vectors using Mel-Frequency Cepstral Coefficient (MFCC) and Linear Predictive Coefficient (LPC) algorithms. We will train the classifier with these feature algorithms.
5) We will train the classifier with these feature vectors, this process occurs in training phase. After that we will take another input sample for testing and compare these signals with database which is acquired during training phase.

### *A. Data Collection*

Data collection is simply how information is gathered. Data collection is done with the help of microphone. Data is collected either at workstation or at any road.

1. Training: Training will be done on 60% of 20 samples of each class given training classifier.
2. Testing: Testing will be done on 40% of 18 samples of each class given for testing classifier.

### *B.* Feature Extraction technique

The task of acoustic signal is to extract characteristic feature of the utterance.

The acoustic signal includes among others, the following algorithmic blocks. Fast Fourier transform (FFT), discrete cosine transform (DCT) widely used features are linear predictive coding (LPC). Another well known extraction is based on mel-frequency Cepstral coefficient (MFCC).

#### (i) LPC (Linear Predictive Coding)

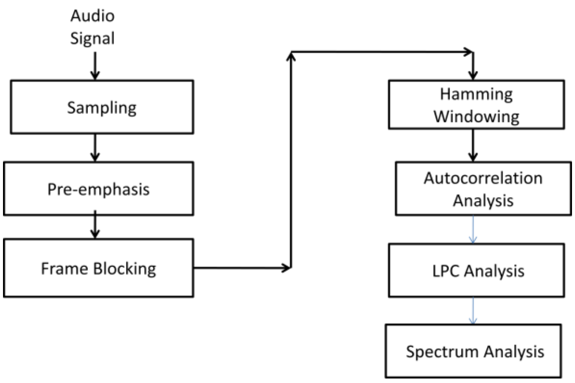


Fig. Block diagram of LPC

It is desirable to compress signal for efficient transmission and storage. Digital signal is compressed before transmission for efficient utilization of channels on wireless media. For medium or low bit rate coder, LPC is most widely used [3]. The LPC calculates a power spectrum of the signal. It is used for formant analysis. LPC is one of the most powerful analysis techniques and it has gained popularity as a formant estimation technique [5]. While we pass the signal from analysis filter to remove the redundancy in signal, residual error is generated as an output. It can be quantized by smaller number of bits compare to original signal. So now, instead of transferring entire signal we can transfer this residual error and speech parameters to generate the original signal. In this technique, the obtained LPC coefficients describe the formants. Thus, with this method, the locations of the formants in a audio signal are estimated by computing the linear predictive coefficients over a sliding window and finding the peaks in the spectrum of the resulting LP filter. We have excluded 0th coefficient and used next ten LPC Coefficients.

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(ii) MFCC (Mel Frequency Cepstral Coefficient)

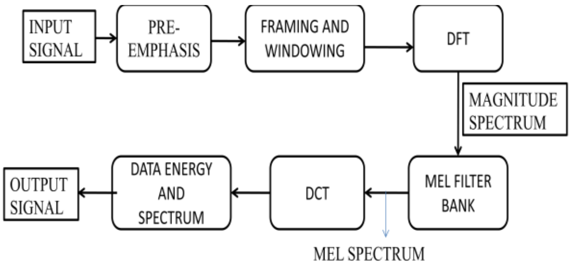



Fig. Block diagram of MFCC

The most prevalent and dominant method used to extract spectral features is calculating Mel-Frequency Cepstral Coefficients (MFCC). MFCCs are one of the most popular feature extraction techniques used in speech recognition based on frequency domain using the Mel scale which is based on the human ear scale. MFCCs being considered as frequency domain features are much more accurate than time domain features.

Mel-Frequency Cepstral Coefficients (MFCC) is a representation of the real cepstral of a windowed short- time signal derived from the Fast Fourier Transform (FFT) of that signal. The difference from the real cepstral is that a nonlinear frequency scale is used, which approximates the behaviour of the auditory system. Additionally, these coefficients are robust and reliable to variations.

In most systems overlapping of the frames is used to smooth transition from frame to frame. Each time frame is then windowed with Hamming window to eliminate discontinuities at the edges. The filter coefficients w (n) of a Hamming window of length n are computed according, Where N is total number of sample and n is current sample. After the windowing, Fast Fourier Transformation (FFT) is calculated for each frame to extract frequency components of a signal in the time- domain. FFT is used to speed up the processing. The logarithmic Mel-Scaled filter bank is applied to the Fourier transformed frame. This scale is approximately linear up to 1 kHz, and logarithmic at greater frequencies. Mel-scale filter bank consist of the higher frequency filters which have greater bandwidth than the lower frequency filters, but their temporal resolutions are the same.

The last step is to calculate Discrete Cosine Transformation (DCT) of the outputs from the filter

DCT ranges coefficients according to significance, whereby the 0th coefficient is excluded since it is unreliable. The overall procedure of MFCC extraction is shown on Figure.

For each frame, a set of MFCC is computed. This set of coefficients is called an acoustic vector which represents the phonetically important characteristics and is very useful for further analysis and processing. We can take audio of 2 Second which gives approximate 128 frames each contain 128 samples (window size = 16 ms). We can use first 20 to 40 frames that give good estimation of speech. Total of forty Two MFCC parameters include twelve original, twelve delta (First order derivative), twelve delta-delta (Second order derivative), three log energy and three 0th parameter.

### C. *Classifier used*

Two different classifiers SVM and Neural network will be in this work and the classification performance of each of them is reported after implementation.

#### *(i) SVM (Support Vector Machine)*

Support Vector Machine is used for the purpose of classification and regression. SVM does not have prior knowledge about problem but learns during training phase. Generalization capacity is major advantage of SVM. This feature makes it better than most of the other models present in this field SVM works equally for both linearly separable data as well as non- linearly separable data. The major advantage of SVM is its ability to classify unknown data set with high accuracy. The number of affiliations, the final affiliation will be centered on the page; all previous will be in two columns.

#### (ii) *Neural Network*

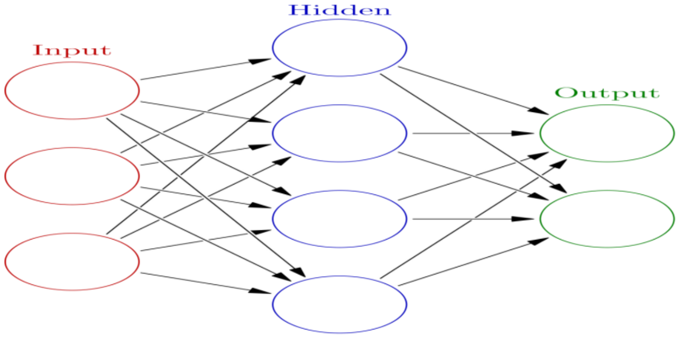



Fig. Structure of neural network

The Generalization is the beauty of artificial neural network. It provides fantastic simulation of information processing analogues to human nervous system.

Multilayer feed forward network with back propagation algorithm is the common choice in classification and pattern recognition. Hidden Markov Model, Gaussian Mixture Model, Vector Quantization are the some of the techniques for acoustic features to visual speech movement. Neural network is one of the good choices among all. Genetic Algorithm can be used with neural network for performance improvement by optimizing parameter combination.

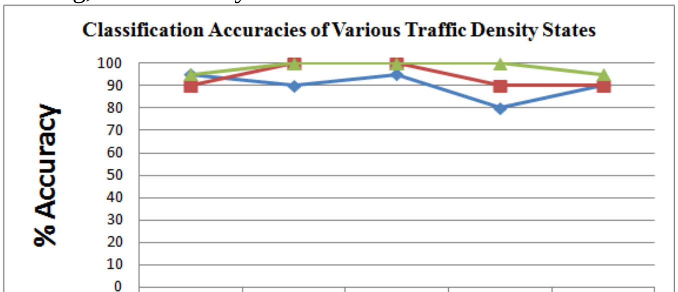
We can use multi-layer feed forward back propagation neural network as shown in Figure with total number of features as number of input neurons in input layer for LPC, PLP and MFCC parameters respectively. As shown in Figure 4 Neural Network consists of input layer, hidden layer and output layer. Variable number of hidden layer neurons can be tested for best results. We can train network for different combinations of epochs with goal as minimum error rate.

## 6. OVERALL ANALYSIS OF REPORTED WORK

Cumulative vehicle count curves (N-curves) which refers to extreme traffic density associated with completely stopped traffic.

Based on this analysis, low income and children suffers the symptoms of asthma.

A real time traffic analysis system using computer vision results of this work culminate in object detection, object tracking, traffic density.




| | Linear | Quadratic | Polynomial | RBF | MPL |
|---|---|---|---|---|---|
| Low | 95 | 90 | 95 | 80 | 90 |
| Medium | 90 | 100 | 100 | 90 | 90 |
| Heavy | 95 | 100 | 100 | 100 | 95 |

Table no.7.1 Classification Accuracies of Various Traffic Density States

The considered traffic models predict a nice uniform traffic flow at low traffic estimates are local peaks of high traffic density, although the average traffic density demonstrates that jammers can serve.
An analysis of urban growth trends in post economic reforms overall the unplanned and uncontrolled rapid growth has resulted in higher growth and larger concentration of urban population in metropolitan areas are increase in the low and medium density areas and decrease in the high.

## 7. RESULT

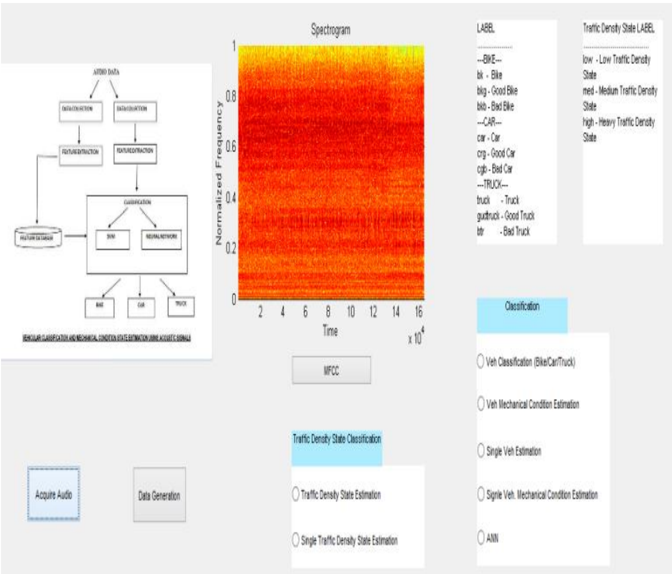



Fig. 8.1 Results In GUI Window


Fig. 8.2 SPECTROGRAM OF THE LOW (Free-flowing) TRAFFIC (Above 40 Km/h)

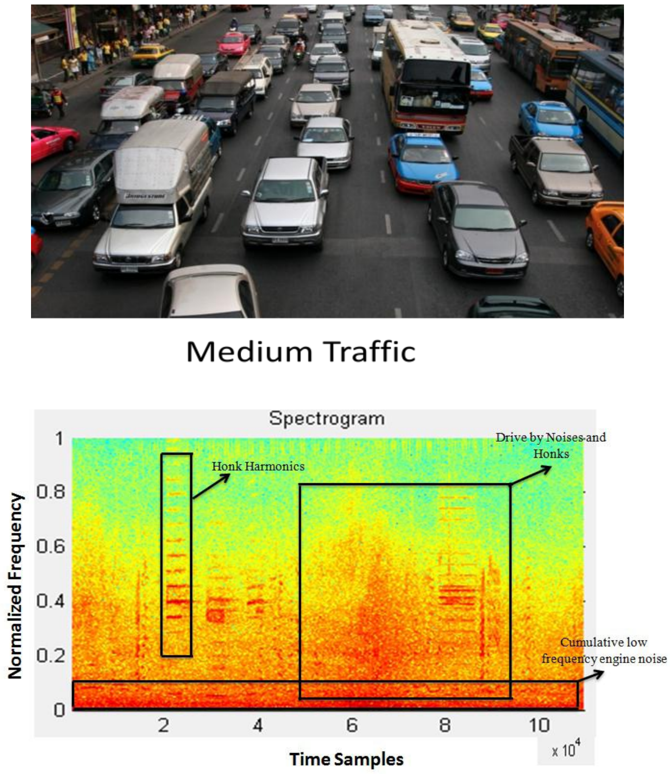



Fig. 8.3 SPECTROGRAM OF THE MEDIUM FLOW TRAFFIC (20 to 40 km/h)

Heavy Traffic

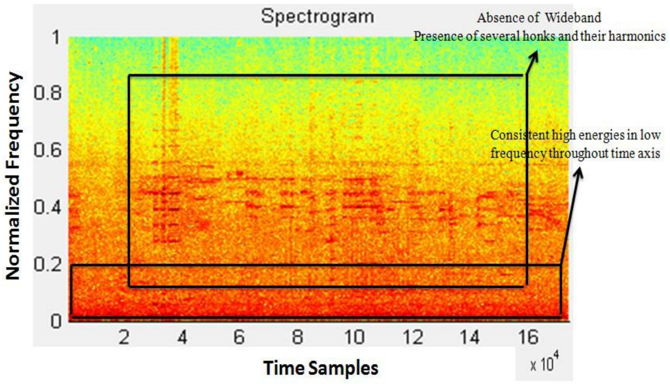



Fig. 8.4 SPECTROGRAM OF THE HEAVY (Jammed) TRAFFIC (0 To 20 Km/h).

## 8. CONCLUSIONS

By reviewing the above literature we can estimate the three probable conditions of the traffic that is free flow, medium flow, and heavy flow traffic. The MFCC and LPC (algorithms) are the most frequently used feature extraction technique used to classify by using SVM and Neural network classifier. The classification of traffic density can be extended in a way that extracted feature are utilized. New application areas are likely to emerge for traffic signal optimization using acoustic signal. In future we can try to improve this system to be a text independent vehicular classification system

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