International Journal of Future Generation Communication and Networking
Vol. 13, No. 2s, (2020), pp. 106–112

Artificial Neural Network to Identify Indian Classical Music Raga's

Alnaz Farishta[1], P.P.Rathod[2], Shraddha Barbole[3], Piyush Belkhede[4]

[1,2,3,4] *Dept. of E & TC Engg., Smt. Kashibai Navale College of Engineering, Pune ,SavitribaiPhule Pune University, Pune*

[1]*alnazfarishta1097@gmail.com*

[2]*pravinkumar.rathod_skncoe@sinhgad.edu*

[3]*shraddhabarbole177@gmail.com*

[4]*pbpiyush2@gmail.com*

Abstract

The music plays a very crucial role in the life of humans. In a day to day life people listen to music for fun, relaxation, entertainment and mental peace. The music also can be used as a remedy to recover from many diseases and physical fatigues. The Raga is the base of Indian Classical Music. The behaviour of the Raga is recognized by Swara notes movement. The Raga may be sung as per emotions, environmental situations and events at a particular time. The various features extraction techniques from the Digital Signal Processing and Raga Identification Techniques for classifying Indian Classical Music are been discussed. In this paper, the properties of Indian Classical Music are listed that are useful for the Identification of Raga's.

Keywords— *ICM(Indian Classical Music), Raga, Music, Arohana-Avarohana.*

I. INTRODUCTION

The music expresses the feelings with the different movements of the sound. It is the most inspired and pure form of creativity by the humans. The experience of music gives the fun, entertainment, relaxation and mental peace to the humans at the different moments of life. In the modern world, the music has gained honoured of healing mental illness and physical fatigue. there are many National and International organizations working on the Music Therapy. The main goal of the organizations is to make aware, educate, practice and research in the Music Therapy for the health care of common people. Few organizations have identified and listed the suitable Ragas which help to cure a particular disease. Music information retrieval is the need of the hour due to the availability of large amount of music on the Internet. Music information retrieval can be thought of as part of Multimedia information retrieval. A lot of work has been done in the other components of multimedia like text, video and the one that is yet to be fully developed is audio. Audio processing involves processing speech and music.

The classification of Indian Classical Music (ICM) based on Raga will help to e-learners, composers, musicians in an efficient retrieval of data. The ICM has categorized in two types Carnatic and Hindustani Music. The Carnatic music has the Melakartha Raga and Janya Raga, while the Hindustanimusic has Thaat and Raga. The Melakartha Ragas are called as sampoorna Raga which has all seven Swaras present. The Hindustani music has ten Thaat: Bhairavi, Asawari, Bilawal, Khamaj, Kalyan, Marva, Poorvi, Todi, Kafi, and Bhairav. Every Raga belongs to a Thaat. The ICM has twelve basic notes or Swaras. The Swaras are categorized as Shuddha (natural), Komal (flat) and Tivra (sharp) Swara. The Swaras can be considered in three different tones namely Mandra (low), Madhya (middle) and Tar (high) that generates 36 distinct notes. Every Raga has Aaroh and Avaroh which defines, as ascending and descending sequence of Swara respectively. The characteristic phrases or set of Swaras which uniquely identifies the Raga called as Pakad. The Identification of Raga based on Aaroh-Avaroh or the pakad is not the just string matching. The two Ragas may have same Swaras, but the way of expressing it may be different, which provides distinct feeling.

ISSN: 2233-7857 IJFGCN

I. LITERATURE SURVEY

Sr No.	References	Purpose	Technology used	Advantages	Disadvantages
1.	"Raga identification of Carnatic music information retrieval"	To purpose a Raga identification of Carnatic music	Pitch values and string-matching algorithm	Better and accurate identification	The assumption of fundamental frequency.
2.	Hindustani Raga representation and identification.	To purpose the representation of Raga.	Manually detected Pitch values and HMM	Better Representation	Less efficient.
3.	Raga mining of Indian music by extracting Arohana-Avarohana pattern.	To purpose extraction of Arohana-Avrohana pattern	Pitch values and ANN	Works successfully for monophonic songs.	Does not work successfully for even polyphonic songs.
4.	"Tansen: A system for automatic Raga identification.	To purpose automatic Raga identification	Pitch values and HMM	Multi-phonic note identification.	Cannotidentify polyphonic note efficiently.
5.	RAAG RECOGNITION USING PITCH-CLASS AND PITCH-CLASS DYAD DISTRIBUTION	To find the results of the first large-scale raagrecog-nition experiment.	markov model and PCD	helps in classifying even after identical sets of notes	ifficulty in classifying relatively loud and complex accompaniment and low SNR conditions.
6.	Automatic raag classification using sprectally derived tone profiles	To find accuracy using spectrally derived tone profiles.	Hidden Markov Model	Characteristic shape independent of the instrument high accuracy.	Time consuming.
7.	Automatic Chord Recognition from Audio Using Enhanced Pitch Class Profile	analyzing the overall harmonic structure of a musical piece using automation of chord labelling	Chromagram or Enhanced pitch class profile, support vector machine, hidden markov model	This smoothing process reduces errors due to sudden changes in signals caused by transient and noise-like sounds, which can obscure harmonic components.	the errors like confusion is created at some extent.
8.	Understanding emotion in Raag: An empirical study of listener Responses	To find the consistency of emotional responses in Raag	Artificial Neural Network	Clear patterns of raat and musical features	Larger sets requires more dimension
9.	Computaional Musicology for Raga Analysis in Indian Classical Music: A Critical View.	It explains evolution of computational musicology field and existing work done in the context of Western Music	Computational Musicology.	Automatically classifying keys and chords using a computer program.	Similarities between the ragas can add to the complexity as ragas having set of notes may generate same

		with Indian Classical Music.			sequence.

II. PROPOSED WORK

It is the conversion of input song into sequence of notes i.e. swara script. In the frequency extraction is done through finding fundamental frequency of each segment and converting it into swaras. From input files, swara combination, number of swaras used in raga, generated for non-linear RAGA. A Neural Network is used for the training purpose. Features of two-three songs selected are random and given as input to training system. System generates weights according to input given. This is tested which gives Feature extraction is the first required step for Raga Identification. The various feature extraction techniques based on timbre, pitch, and tempo are available. The well known Timbre features are Linear Prediction Coefficients (LPC), Mel Frequency Cepstral Coefficient (MFCC) and so on. The features are obtained by applying various signal processing techniques like Fourier Transform, Short Term Fourier Transform (STFT) and Wavelet Transform (WT). The pitch determines the fundamental frequency of the sound. The Pitch Class Profile (PCP) and Harmonic Pitch Class Profile (HPCP) are widely used in tasks like melody extraction and note extraction.

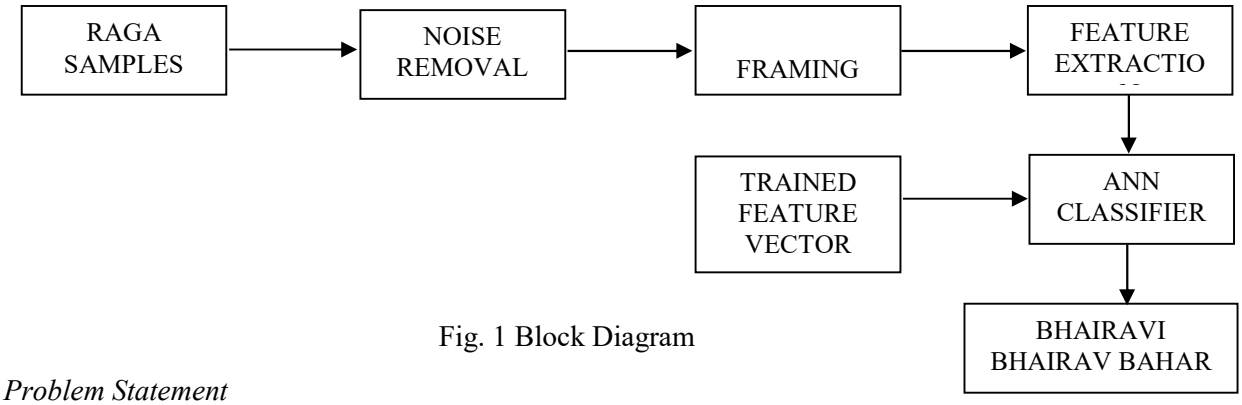


Fig. 1 Block Diagram

A. Problem Statement

The objective of the paper is to develop a system which automatically mines the raga of an Indian Classical Music. The fig shows the configuration of the proposed system. As a first step Note transcription is applied on a given audio file to generate the sequence of notes used to play the song. The features related to Arohana – Avarohana are extracted in the next step. These features are given to the Artificial Neural Networks for training and testing the system.

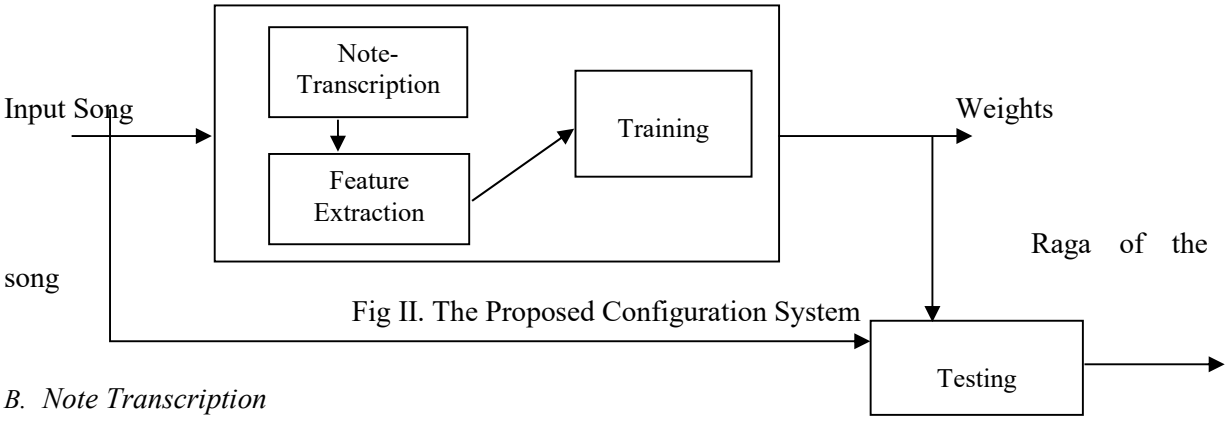


Fig II. The Proposed Configuration System

B. Note Transcription

In order to identify the raga of the songs, the sequence of notes used to play the song must be known. The process of identifying the sequence of notes i.e the swara script is called as Note Transcription. For the Indian classical music, Note Transcription process itself is a very challenging task and two heuristics are been used, based on the pitch of the audio sample for Note transcription, The Hill Peak Heuristic and Note Duration Heuristic. Sound onset detection and musical meter estimation was proposed by Kalpuri for Note transcription in Indian Classical Music. Here we illustrate a method for this process and discuss the incurred problems.Music is represented as signals, so note transcription involves signal Processing techniques. Music can be defined as the melody composed by the combination of swaras, whereswara is bunch of set of frequencies – Fundamental frequency and harmonic frequencies. The human perception of these set of frequency is called as Pitch. The very first step in Note Transcription is identifying all different frequency segments in the song called as 'Frequency Extraction'. Fundamental frequency of each segment is calculated using the Autocorrelation method with a frame-size of 50ms. For simplifying the type of the input audio file taken is monophonic song with a single sound-source. System can be enhanced further for recorded Polyphonic music, by applying multi-pitch detection techniques described in. After listing all the frequency segments in the audio file, each such segment has to be converted into its corresponding swara.

C. Feature Extraction

A raga is defined by: The choice of notes (from the 12 notes), Ascending and descending sequences (arohana&avarohana). these features help to identify the raga. A raga is been constructed of five to seven consistent svaras (melodic steps). Each raga has an ascending (arohana) and descending (avarohana) form; i.e. the arohana and avarohana may contain different svaras; Arohanais the ascending sequence of notes which the raga follows. Any ascending sequence in improvised portions of the raga follows the pattern defined in Arohanastrictly. Similarly, Avarohana is the corresponding descending sequence. In our system the features which are extracted from the input files are, Swara Combination, Numbers of swaras used in the raga, Vakra pairs in Arohana& in Avarohana. Arohana-avarohana pattern in ragas Swara combination is nothing but basic set of notes(swara) which is used to compose a musical script. Swara combinations are represented in bits. The binary sequence is converted into decimal value For Example, Mohana Raga, The swara combination is: s r2 g2 p d2. So, But, as 's' is present in all the ragas we can ignore the value and the binary sequence will be, 01010010100 – 660. Another feature is also one of the characteristics of raga. It tells about the number of distinguished swaras used in the raga. Example 1: Mohana Raga, the swara combination is: s r2 g2 p d2. Numbers of swaras are: 05 Example 2: Todi, the swara combination is, S r1 g1 m1 p d1 n1, Number of swaras are:07 The Arohana and Avarohana of the raga can be either linear or non-linear. In linear, the Arohana and Avarohana pattern is the same as the swara combination in ascending and descending sequence respectively. In case of non-linear the Arohana-Avarohana pattern may have some of the pairs which are not present in ascending/descending sequence of swara-combination. Such pairs in non-linear arohana-avarohana are called as vakra. For example, 1. Chakravak raga (linear) Swara combination sequence, s r1 g2 m1 p d2 n1 Linear arohana: s r1 g2 m1 p d2 n1 s' Linear Avarohana: s' n1 d2 p m1 g2 r1 s 2. Dhanyasi raga (Non-linear) Swara Combination sequence, s r1 g1 m1 p d1 n1 Aroahana: S g1 m1 p n1 s' Avaraohana : s' n1 d1 p m1 g1 r1 s Vakra pairs are, (s g1) and (p n1) Here we find out the set of 2 vakra pairs in arohana and 2 vakra pairs in avarohana. Each possible pair is assigned a value according to which the features are generated.

RAGA	SWARA Combination	AROHANA/AVAROHANA
Todi	s r1 g1 m1 p d1 n1	S r1 g1 m1 p d1 n1 s'/ s' n1 d1 p m1 g1 r1 s
Dhanyasi	S r1 g1 m1 p d1 n1	S g1 m1 p n1 s' / s' n1 d1 p m1 g1 r1 s
Varali	S r1 g1 m2 p d1 n2	S r1 g1 m2 p d1 n2 s' / s' n2 d1 p m2 g1 r1 s
Mayamalavagaula	S r1 g2 m1 p d1 n2	S r1 g2 m1 p d1 n2 s' / s' n2 d1 p m1 g2 r1 s
Saveri	S r1 g2 m1 p d1 n2	S r1 m1 p d1 s' / s' n2 d1 p m1 g2 r1 s

Chakravak	S r1 g2 m1 p d2 n1	S r1 g2 m1 p d2 n1 s' / s' n1 d2 p m1 g2 r1 s
Gaula	S r1 g2 m1 p n2	S r1 m1 p n2 s' / s' n2 p m1 r1 s
Kamavardhini	S r1 g2 m2 p d1 n2	S r1 g2 m2 p d1 n2 s' / s' n2 d1 p m2 g2 r1 s
Saurashtra	S r1 g2 m1 p d2 n1 n2	S r1 g2 m1 p d2 n2 s' / s' n1 d2n1 d2 p m1 g2 r1 s
Abheri	S r2 g1 m1 p d2 n1	S g1 m1 p n1 s' / s' n2 d2 p m1 g1 r2 s
Anandabhairavi	S r2 g1 m1 p d2 n1	S g1 r2 g1 m1 p d2p s' / s' n1 d2 p m1 g1 r2 s
Bhairavi	S r2 g1 m1 p d1 d2 n1	S r2 g1 m1 p d2 n1 s' / s' n1 d1 p m1 g1 r2 s

Table I. Arohana- Avarohana Pattern in Ragas

D. Training and Testing

A neural network is constructed by highlyinterconnected processing units (nodes or neurons) that perform simple mathematical operations. Neural networks are characterized by their topologies, weight vectors and activation function which are used in the hidden layers and output layer. The topology refers to the number of hidden layers and connection between nodes in the hidden layers. The activation functions can be used are sigmoid, hyperbolic tangent and sine.The network models can be static or dynamic. Static networks include single layer perceptrons and multilayer perceptron.

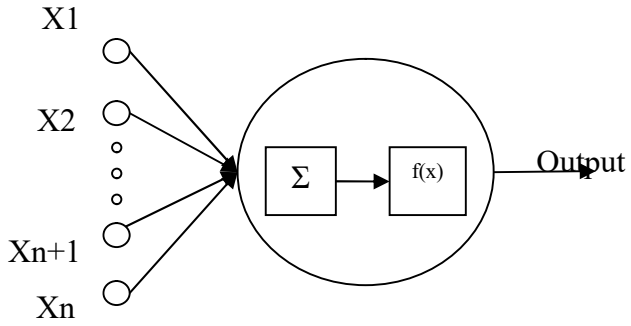
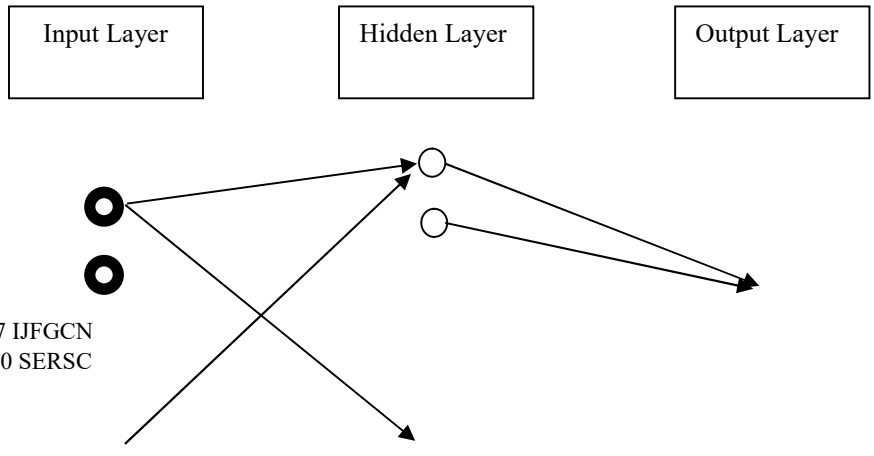
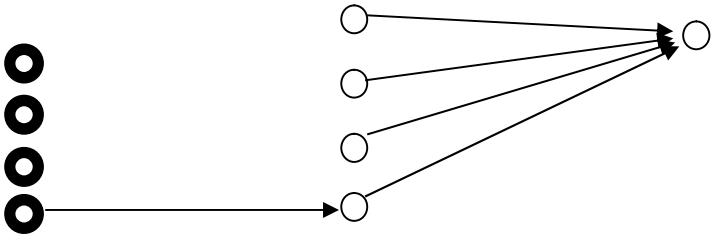


Fig III: Function of a Neuron

A multilayer perceptron is shown schematically. The information flows in a feed-forward manner from i/p layer to the o/p layer through the hidden layers. The number of nodes in the input layer and output layer are fixed. It depends upon the number of input variables and the number of output variables in a pattern. In this work, there are six i/p variables and one o/p variable. The number of nodes in a hidden layer and the number of hidden layers are variable. Depending upon the type of application, the network parameters such as the number of nodes in the hidden layers and the number of hidden layers are found by trial and error method.





.

Fig IV: Multilayer Perceptron

In most of the applications, only one hidden layer is sufficient. The activation function which is used to train the Artificial Neural Networks is the sigmoid function and it is given by:

$$f(x) = 1/(1 + \exp(-x)) \quad \text{.....[1]}$$

$$f(x) = \sum_{i=1}^{N} \left(W_{ij}(p)x_i(p) + \theta(p)\right) \quad \text{.....[2]}$$

III. CONCLUSIONS

Raga in an Indian Music is a very complex structure. The sequence of notes used to play the songs is based on the raga. The sequence of notes for Raga identification has been analysed. The arohana – avarohana and swara combination pattern is well defined for each raga so it is very useful feature in identification of the raga. The system works successfully for monophonic song. This method works well for even polyphonic songs, however with some qualms in frequency extraction. This is due to the fact that rhythmic instruments do not contribute to the rag, but only the beat, and yet superimpose frequency components in the spectrum. The system is been enhanced further by generating a complete swara-script containing notes and rhythm information which will be very useful for musicians. The method of raga identification is improved by using rhythmic information.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude and regards to our project guide Prof.P.P.Rathod Department of Electronics and Telecommunication Engineering, Smt. Kashibai Navale College of Engineering, for his patience, motivation, enthusiasm and unconditional guidance with immense knowledge. His guidance helped us in all the time, may it be of research or writing of this thesis. We are very thankful to the Honourable Principal of Smt. Kashibai Navale College of Engineering, Pune, Dr. A. V. Deshpande for his support. We are highly grateful to Dr. S. K. Jagtap Head of Department of Electronics and Telecommunication Engineering, Smt. Kashibai Navale College of Engineering, Pune for providing necessary facilities during the course of this work .We are also very thankful to Prof. S.M. Ingawale and Prof.P.G.Chilveri Project Coordinator ,Department of Electronics and Telecommunication Engineering, Smt. Kashibai Navale College of Engineering, for enlightening us with such an opportunity to carry on this innovative project.

REFERENCES

[1]R.Shridhar and T. V. Geetha, “Raga identification of Carnatic music information retrieval,” International Journal of Recent Trends in Engineering, vol. 1, no. 1, pp. 571-574, 2009.

[2] A. Bhattacharjee and N. Sriniwasan, “Hindustani Raga representation and identification: A transition probability based approach,” International Journal of Mind, Brain and Cognition, vol. 2, pp. 65-93, 2011.

[3] S.Shetty and K. K. Achary, “Raga mining of Indian music by extracting Arohana-Avarohana pattern,” International Journal of Recent Trends in Engineering, vol. 1, no. 1, pp. 362-366, May 2009.

[4] G.Pandey, C. Mishra, and P. Ipe, “Tansen: A system for automatic Raga identification,” in Proc. 1st Indian International Conference on Artificial Intelligence, Hyderabad, India, 2003, pp. 1350-1363.

[5]Parag chord is, Rae, A. “Raag recognition using pitch-class and pitch-class dyad distributions”, In Proceedings of International Conference on Music Information Retrieval, (2007)[6] Qun Gao∗ and George S. Moschytz ,”Fingerprint Feature Extraction Using CNNs ”ECCTD’01 - European Conference on Circuit Theory and Design, August 28-31, 2001, Espoo, Finland

[6] Parag chord is, “Automatic rag classification using spectrally derived tone profiles”, In Proceedings of the International Computer Music Conference, 2004, volume 129, pp 83-87.

[7] Kyogu Lee, “Automatic chord recognition from audio using enhanced pitch profile:, ICmC 2006.

[8] Parag Chordia, "Understanding Emotion in Raag: An Empirical Survey of Listener Responses." In Proc. of the 2007 International Computer Music Conference (ICMC).

[9]Kunjal Gajjar, Mukesh Patel. "Computaional Musicology for Raga Analysis in Indian Classical Music: A Critical View." International Journal of Computer Applications (0975-8887) Volume 172-No.9, August 2017

[10]Prof. Sambamurthy, South Indian Music, vol 4, The Indian Music Publishing House, Madras, India, 1982.

[11] Bernard Widrow (1990), 30 Years of adaptive neural networks: Perceptron, madaline and back-propagation, Proc. of the IEEE, 18(9), pp 1415 - 1442.

[12] Hirose Y, Yamashita K Y and Hijiya S (1991), Back-propagation algorithm which varies the number of hidden units, Neural Networks, 4, pp 61-66.

[13] Fortuna L, Graziani S, LoPresti M and Muscato G (1992), “Improving back-propagation learning using auxiliary neural networks,” Int. J of Control , 55(4), pp 793-807.

[14] S. K. Padmanabha Acharya, “PanchamaVeda”, Published by S.K. Padmanabha Acharya, Kasargod, India, 2001.

[15] Preeti Rao and Anand Raju, “Building a melody retrieval system:, NCC 2002.

[16] Alai de Cheveigne, “YIN, a Fundamental frequency estimator for speech and music”, Journal of Acoustical Society of America., Vol. 111, No. 4, April 2002.

[17] Krishnaswamy, A, “Application of pitch tracking to South Indian classical music”, Applications of Signal Processing to Audio and Acoustics, 2003 IEEE Workshop on 19-22 Oct. 2003.

[18] Anssi Klapuri, “Signal Processing Methods for the Automatic Transcription of Music”, Thesis for the degree of Doctor of Technology, USA, 2004.

[19] Parag Chordia, “Automatic raag classification of pitchtracked performances using pitch-class and pitch-class dyad distributions”, In Proceedings of International Computer Music Conference, 2006

[20] S. Shetty and K. K. Achary, “Raga mining of Indian music by extracting Arohana-Avarohana pattern,” International Journal of Recent Trends in Engineering, vol. 1, no. 1, pp. 362-366, May 2009.

ISSN: 2233-7857 IJFGCN