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Video Classification using Fractional Fourier Transformed Content of Video

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Abstract— Advanced technology has resulted in drastic growth of multimedia data. In day to day life huge amount of multimedia data is generated an uploaded over web. Storing this multimedia data has become a challenging task. Storing the data in video format efficiently and retrieving it accurately has become important. If the data is appropriately classified under different categories and then stored, it can be retrieved faster. In this paper a novel video classification techniques has been proposed to classify the videos. Transform domain has the property of energy compaction that helps to figure out the important data in the video and neglect the least important data. Thus the proposed techniques uses the Fourier transformed video content as the attributes for classification process. Twelve different classification algorithms are used and six fractional portions of transformed content forming the feature vectors of six different sizes are experimented. With the proposed technique highest classification accuracy of 89.16% is obtained.

Keywords— Content based video classification, Fourier transform, Fractional energy, data mining classifiers.

I. INTRODUCTION

Various video analysis applications require storing the huge amount of data that is generated from cell phones, surveillance cameras, animations, movies etc. Automatic Content based video classification for large video database that is even becoming larger has become more apparent.

Content based video classification is the process of classifying the videos into the set of predefined classes based on the attributes or features. This attributes can be the colours in video, shapes that makes the objects in the video, textures, audios, music, transformed contents etc. A single feature vector can be formed by using this attributes to represent the video. This attributes can be extracted using various image processing techniques such as RGB histogram, Block truncation coding to extract the colours [1] [3], Canny edge detection technique to get the shapes from videos [1]. Mel-Frequency Cepstral Coefficient (MFCC), Scale Invariant Feature Transform (SIFT), STIP methods are used to extract the audio [2]. Orthogonal transforms are used to get transformed features with energy compaction [4].

In this paper, to form the feature vector for the representation of video key frames are extracted. For each key the transformed content are extracted using the Fourier transform and finally the classification process is carried out using Naive Bayes, Bayes Net, RBFNetwork , Simple Logistic, IB1, Kstar, Decision, Part, BFTree, J48, Random Tree and Random Forest classifiers.

II. LITERATURE SURVEY

In [4] authors have used Cosine, Sine and Walsh transforms to get attributes for video classification. Row mean is computed of the transformed content. The fractional energy is considered to form the feature vector of various sizes.

Kekre, Hartley, Haar and Slant transforms are used to form the feature vector in [5]. The technique used in [4] is extended with four different transforms and comparative analysis of seven different transforms is given.

To get the transformed content of key frames in proposed technique Fast Fourier transform is used and explained in detail in section A.

A. Fast Fourier Transform.

The fast Fourier transform (FFT) is a discrete Fourier transform algorithm which reduces the number of computations needed for N points from $2N^2$ to $2N \lg N$, where lg is the base-2 logarithm. The fast Fourier transform is applied on data x, using equation 1. [6]

$$X(k) = \sum_{j=1}^{N} x(j)\omega_N^{(j-1)(k-1)} \quad (1)$$

B. Data Mining Classifiers

Classification is a data mining technique which has a set of predefined classes and determines which class a new object belongs to [7]. There are large numbers of classifiers available which are used to classify the data from various families such as bays, function, Rule, lazy, Meta, decision tree etc.

i . Bayes Classifier

Bayes method is also used for classification in data mining[8] .There are six Bayesian method such as AODE, ADOEsr, Naive Bayes, Bayesian Net, Naive Bayes Simple, Naive Bayes updatable. Here Bayes and Bayesian Net classification method are used. Naive Byes classifier makes assumption about independence of the attributes. Bayes Rules are used to predict the class with some feature values.

ii . Function Classifier

Neural Network and regression are the concepts used by Function Classifier. Function classifier can be written down as mathematical equation in natural way. Another methods such as decision tree and rules cannot [9]. The various methods of function classifier are Linear Regression, Logistic, Functions Logistic, RBNFNetwork, etc. Here RBFNetwork and Simple Logistic methods are used.

RBFNetwork trains the hidden layer in an unsupervised manner, and RBFRegressor and RBFClassifier, which are fully supervised. RBFNetwork implements a normalized Gaussian radial basis function network. It uses the k-means clustering algorithm to provide the basis functions and learns either a logistic regression (discrete class problems) or linear regression (numeric class problems) on top of that. Symmetric multivariate Gaussians are fit to the data from each cluster.

iii. Rule Classifier

Interesting relationship among all attributes can b found by using Association Rules. More than one conclusion is predicted by the rule classifier. Different methods in rules classifier are Conjunctive Rule, Decision table, DTNB, PART, Zero, JRip, NNge, Rider. Here PART and Decision table methods are used. PART obtains rules from partial decision trees[7].It builds the tree using C4.5's heuristics with the same user defined parameters as J4.8.

iv. Lazy Classifier

Lazy learners store the training instances and do no real work until classification time[9].It supports incremental learning. Different lazy classifier methods are IB1, IBK, K-Star, LWL, LBR. For our data set we have used IB1 and K-Star algorithm. IB1-type classifier uses a simple distance measure to find the training instance closest to the given test instance, and predicts the same class as this training instance. If multiple instances are the same (smallest) distance to the test instance, the first one found is used. K-Star is a nearest neighbor method with a generalized distance function based on transformations.

v. Decision Trees

Decision Trees specify the sequence of decision that needs to be made along with the resulting recommendation [9]. A Divide and Conquer approach to the problem of learning from a set of independent instances leads naturally to a style of representation called a decision tree[9].There are different methods for decision tree such as ADTree, BFTree, J48, J48graft, DecisionStump ,RandomForest, RandomTree etc. For our data set we have used BFTree, J48, RandomForest and RandomTree.

Based on the highest value of the Information Gain and Entropy, it creates a tree of attributes which depicts the arrangement of attribute in tree structure. Improved version of C4.5 is J48.

III. PROPOSED VIDEO CLASSIFICATION APPROACH

To extract the transformed content of the videos the dataset is divided into the training and testing data set. Feature vectors are formed of training data set using the proposed technique and supplied to twelve classifiers to train them. The videos from the testing data sets are given to the trained classifiers to evaluate the classification accuracy

Fig1. Shows the feature extraction technique to form the feature vectors. For each video five key frames are extracted. Key frames are resized to 256 x 256. For each key frame red, green and blue planes are extracted. For each plane the Fourier transform is applied on the column of the plane. Row mean of the column Fourier transformed plane is calculated. Considering the fractional portion of row mean vectors the feature vector of six different sizes are formed. Taking the first fifteen transformed coefficients feature vector of size (15 x 3 x 5) is formed. Similarly first

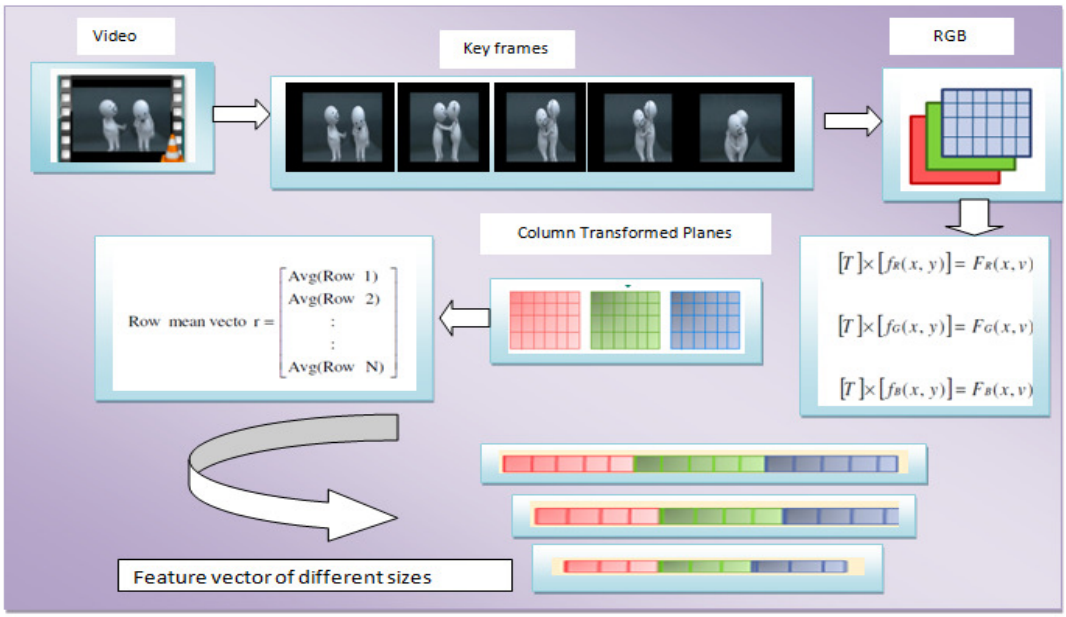

Fig. 1. Feature Extarction Process

Tablel. . Classification Accuracy of Fourier Transformed Video Content.

Classifier		Feature Vector Size (Number of FFT Coefficients Considered)						Average Classification Accuracy (%)	Family wise average classification accuracy
Family	Name	(15x3x5)	(25x3)	(50x3x5)	(75x3x5)	(100x3x5)	(256x3x5)		
Bayes	Navie Bayes	70.83	70.83	65.83	62.5	63.33	68.33	69.94	73.16
	Bayes Net	82.5	81.66	76.66	72.5	70.83	74.16	76.38	
Function	RBFNetwork	76.66	75.83	67.5	75	75	77.5	74.58	79.65
	Simple Logistic	86.66	80.83	81.66	89.16	83.33	86.66	84.72	
Lazy	IB1	78.33	72.5	67.5	66.66	71.66	68.33	70.83	43.74
	Kstar	16.66	16.66	16.66	16.66	16.66	16.66	16.66	
Rules	DecisionTable	75.83	65	65	75.83	75.83	65.83	70.55	69.3
	Part	79.16	63.33	63.33	65	65	72.5	68.05	
Tree	BFTree	74.16	74.16	75	78.33	78.33	79.16	76.52	75.41
	J48	77.5	75	73.33	73.33	74.16	74.16	74.58	
	RandomForest	81.66	88.33	76.66	79.16	73.33	74.16	78.88	
	RandomTree	74.16	62.5	79.16	61.66	70.83	81.66	71.66	

twenty five, fifty, seventy five, hundred and all coefficients (256) are taken into consideration to form the feature vectors.

IV. EXPERIMENTATION ENVIORNMENT

The proposed technique is implemented using Matlab on computer with Intel core i5 processor and 4 GB RAM. Video database used which contains 300 videos of 6 different classes. Fig. 2 shows dataset sample.

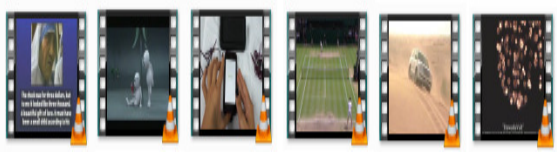

Fig. 2. Testing Dataset Sample video from each of the six classes.

Classification Accuracy is used for performance evaluation to compare the variations of proposed classification technique. The training is done using 180 videos. Total 120 queries are tested to get average accuracy. Accuracy is calculated for different feature vector sizes.

V. RESULTS AND DISCUSSION

Considering the fractional energies of Fourier transformed key frames of 180 training videos, the twelve classifiers belonging to five different families are trained. Table1 shows the experimental results of the proposed classification technique. It shows the classification accuracy given by six different feature vector sizes. It can be observed that Simple Logistic classifier belonging to Function family has given the highest classification accuracy of 89.16%.

Fig3. Shows the comparative analysis of accuracy given by Navie Bayes and Bayes Net classifier of Bayes family. Bayes Net classifier is giving more accuracy 82.5% when feature vector is formed by considering first 15 coefficients only.

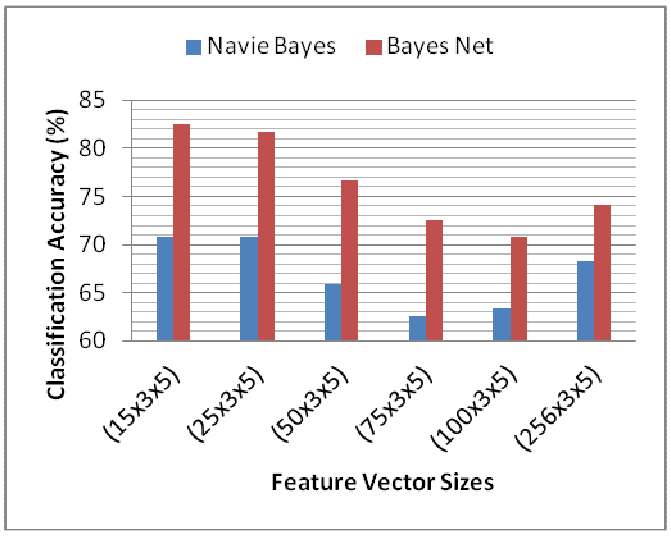

Fig3.Comparative analysis of Bayes family classifier

RBFNetwork and Simple Logistic Classifier are used from the function family. Fig4 shows the classification accuracy given by function family methods. With (75x3x5) feature vector size Simple logistic classifier is giving best classification accuracy.

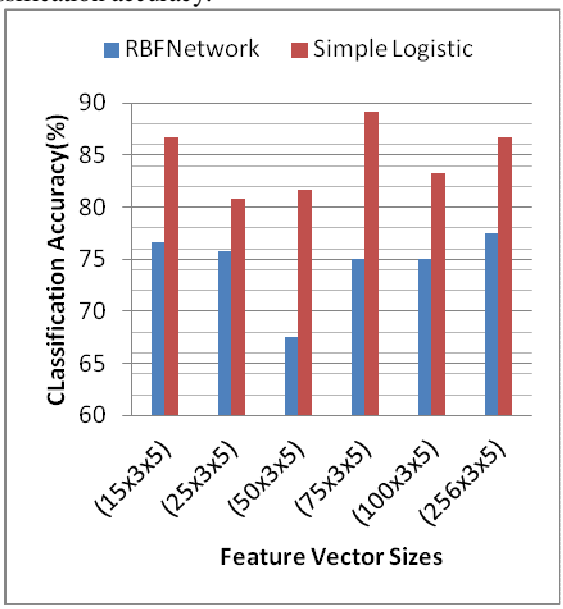

Fig 4. Comparative analysis of Function family classifier.

Lazy Classifier methods, IB1 and Kstar are comprared and analyzed in Fig5. Kstar method has the very poor performance. IB1 method is giving 78.33% highest classification accuracy with (15x3x5) feature vector size.

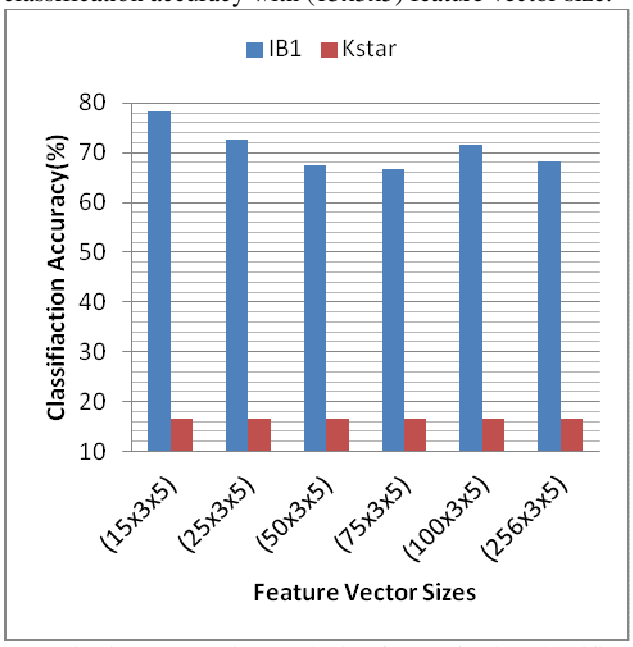

Fig 5. Comparative analysis of Lazy family classifier.

Fig6. Show the Decision Table and Part classifiers performance. Part classifier has given highest 79.86% classification accuracy when compared with Decision Table method. Here again the smallest feature vector of size (15x 3x 5) has given the highest performance.

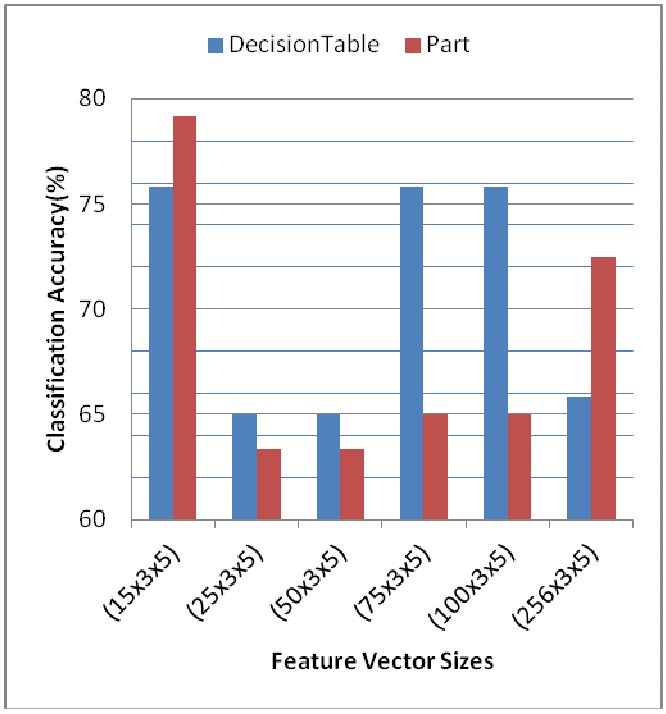

Fig 6. Comparative analysis of Rule family classifier.

From the Tree family BFTree, J48,RandomTree and RandomForest classifiers are compared in Fig7.Among the Tree family methods RandomForest has given the 88.33% of accuracy. Comparing the feature vector sizes (25 x 3 x5) has given the best performance.

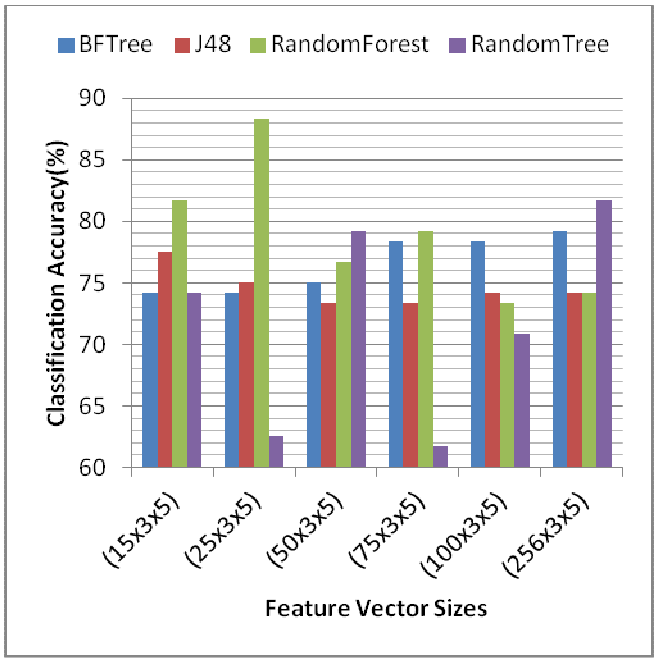

Fig 7. Comparative analysis of Tree family classifier

VI. CONCLUSION

With exponential growth of multimedia data there is apparent need of automatic video classification system for better retrieval. Here using Fourier transform and twelve assorted classifiers are proposed to be used in video classification. The proposed video classification system has given the best classification accuracy with the Simple logistic classifier. Kstar classifier has poor performance as compared to other data mining classifiers considered.

Here the transform are applied only on the columns of the classifier to reduce the computational complexity. Forming the feature vector with fractional portion of the coefficients has given the best performance with reduced size.

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