International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-4, April 2019

Statistical Framework for Effective Retrieval of Images based on Content

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Abstract: ***The new digital technology updates have resulted in huge image capture capabilities using multiple resolution techniques. However, this has led to a disadvantage with respect to storage and recovery efficiencies. To address this problem, content-based image retrieval (CBIR) has been coined and has become the core consideration for the effective recovery of massive data sets. With recovery competencies, CBIR has been used in many applications ranging from medical processing, video and audio recovery and recognition of old documents. In this article, we present a recovery model based on the Bivariable Gamma Blending Model with a perspective on the application of video retrievals from YouTube video conferences considered as a data source. The main advantage of this model is that the recovery of a relevant conference / video clip can be easily recovered, so that users can have their choice of reference within a very short duration. The efficiency of the model is tested using benchmark quality metrics such as the signal-to-noise ratio (SNR), the mean square error (MSE) and the structural similarity index (SSIR) ratio***

Index Terms**: *Content Based Image Retrieval, Generalized Gamma Mixture Model, Signal to Noise Ratio, Mean Square Error, Structural Similarity Index Ratio***

I. INTRODUCTION

Digital innovations in the last decade have resulted into a swift increase in communication technologies and have helped to create mechanisms capable of capturing high resolution images with the most accurate errors. However, these technological updates contributed to the rapid increase in communication devices, particularly mobile applications. Due to this increase in mobile data, the amount of information available on the Internet, storage areas have multiplied, also the accumulated information is collected for numerous applications, in multiple environments and multiple formats. Since, the amount of information is becoming exponentially huge, retrieving the relevant data from the users' interest is a difficult task. In many practical applications, one needs to recover their choice of interest from various search engines such as Google, Yahoo, Bing, etc. The information is stored mainly in an unstructured format and with indifferent names, which resulted in a complicated task during the process. recovery process. One of the most important advantages obtained with respect to this innovation is that, from the point of view of the students, many technical and other data related to education are available. Since the data is exponentially large, the retrieval of relative information is a highly challenging task. In this article, we propose a CBIR methodology, with a perspective to retrieve the relevant video tutorials from a particular area, Computer Science Lectures, available on the Internet according to the interest of the users.Many models are presented in the literature for effective retrieval of relevant information based on users' choice. The models include either generative or degenerative approaches. Generative models are also called as Statistical Mixture Models or Parametric models and help to identify the inherent parameters, thereby helping to identify the features within the video of interest in a broader scope. On contrary, degenerative models or non-parametric model based techniques, such as Co-relation based Approaches, SVM Decomposition Models, Artificial Neural Network based Approaches, Genetic Algorithmic approaches aim at retrieval of relevant images based on the shape, size etc., (T V Madhusudan et al (2015)) (P Auradha et al (2015)), (G G Naidu et al (2015)) (P Chandana et at (2016)), (A Gouthami Latha et al (2016)) Very little work is reported on the applications of academic purposes wherein the relative teaching material against a particular query subject is retrieved. Since the number of technical youth is increasing, it is necessary to see that the best of the best learning material is available at the disposal of the students for their betterment. This article makes an attempt in this direction wherein a particular choice of subject video can be retrieved with ease from the Internet sources with maximal output and minimal time consumption. One of the difficulties that arose, while aiming at retrievals is that, most of the data available in the internet with respect to the video lectures are mostly unformatted, resulting into failure of selecting/retrieving the most relevant data. Hence, it is customary to develop models that can differentiate the necessary data, from the available data, such that, the retrieval efficiency is maximized. In this article, the concept of Bivariate Gamma Mixture Model is considered for the classification purpose. The main advantage beyond the consideration of this model is that, in this model we consider two features for the retrieval purpose, and hence it is assumed to perform better and derive maximum fruitful results. Another advantage beyond the choice of this model is that, several other models such as Laplacian Model, Raleigh Model, Gamma Model and Erlangen Distribution are the particular cases of the considered model. Gaussian Mixture Model is also a part of the shape parameter $\beta = 0.523$.

Manuscript published on 30 April 2019.
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The rest of the article is organized as follows. In section 2 of the paper briefs about the various types of CBIR retrievals, in Section 3, the relevant work carried out in this area is presented. In section 4 of the paper, Bivariate Gamma Mixture Model is presented, in section 5 of the paper the data set considered are presented, in section 6 of the paper the feature set considered for experimentation are presented, section 7 of the paper presents the methodology together with results derived. The concluding section 8 summarizes the paper with the scope for further extension.

II. IMAGE RETRIEVAL METHODS

Basically, image recovery methods are grouped into 3 categories: text-based approach, content based and hybrid. In text-based approaches, the relevant information is retrieved based on the input text and, if a match occurs, the relevant information is retrieved. In content-based recovery approaches, the relevant image is retried based on the description of the text or image and also depending on the characteristics. The hybrid model is a combinational model of the two previous approaches, where the recovery is submitted by text or content or both.

A. TYPES OF CBIR BASED IMAGE RETRIEVAL

a) Semantic retrieval:

CBIR generally takes care of both lower- level features such as texture, color, and shape. In some particular cases, combining of these features is mostly preferred and this is totally application dependent.

b) Relevance Feedback

Another approach of extracting the relevant images is based on relevancy, between the input image and the test images are calculated and based on the relevance, the relevant images are retrieved.

c) Other query methods.

Other models of retrieving the relevant images include: query by image, visual drawing, direct specification of image features, and multimodal queries.

III. RELATED WORK

Over the past 2 decades, a large amount of research has been conducted on computer vision and CBIR. Recent literature on the subject suggests that CBIR technology are mostly focussed on several multiple domains including compliance with the law (Chung, Wang and Chen, 2004; Jain, Lee, Jin and Gregg, 2009; Klare, Li, and Jain, 2011; Shah, Javed, & Shafique, 2007) and fabrication (Banerjee & Zetu, 2001; Chiou, Mookiah, & Kwon, 2009; Kerr, Pengilley, & Garwood, 2006; Lu, Li, and Yu, 2001). This reflected that the use of CBIR techniques could be able to helpful to many domains, also usage of these techniques helped to extract critical components (Conniss, Ashford, and Graham, 2000; Eakins and Graham, 1999). With the advantages of CBIR, it became a choice of research to many researches and also its precedence is greatly seen in the areas of academic archaeologists , art historians, and exhibiting artists. The review conducted in the work Neha & Sandeep (2016) where the authors have considered vector quantization for comparing the images. CBIR is then carried forward using classification techniques. Anu & Tajinder (2016) have considered a descriptor as a feature based upon which the images are retrieved. This descriptor is generated using XOR patterns. S.K.Vipparthi & Nagar (2014) have presented a paper where the similarity between the images are estimated using the peaks in the histogram and the relevant images are retrieved based on these peaks. Subrahmanyam et al (2013) have considered the constrained correlation matrices for estimating the correlation between one image and other and the relevant images are retrieved wherever the correlation factor is minimal. Yamazaki et al (2003), Yeeling Wu (2014) have presented models based on GMM to retrieve the images of interest more effectively

IV. BIVARIATE GAMMA MIXTURE MODEL

In this article, Bivariate Gamma Mixture Model is chosen for developing the proposed framework. The main advantage of this model is that it can interpret the data more robustly as it considers Bivariate features. The features considered include both text and speech. Another advantage behind the choice of this model is that it can consider the different variants of shape parameters and hence can effectively help to retrieve the relevant lectures more accurately. The Probability Density Function (PDF) of the Bivariate Gamma Mixture Model is given by

$$f(x)= \frac{1}{\sigma\sqrt{2\pi}}\int_A^B \exp\left[-\frac{(x-\mu)^2}{2\sigma^2}\right] dx$$

$$where\ A = \log\gamma\ \ and\ B = \log(\gamma+1) \qquad (1)$$

V. DATA SET CONSIDERED

In order to demonstrate the proposed contribution, we have generated a data set by taking into account the various NPTEL lectures and other lectures available free of cost from the Internet sources. These data sets are pooled together such that it contains a heterogeneous group of lecture material

Figure 1: Dataset considered

VI. FEATURE SET

In order to model the proposed architecture, we have considered Bivariate Features namely, Text and Speech. Each of the video lectures is considered and is divided into frames of uniform length. Each frame is pre-processed so that it is free from noise.

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From these frames, the textual information is extracted and is stored in a database. The speech signals are also extracted in the similar manner where the amplitude sequence of each frame is converted to the Mel Cepstral coefficients. These features extracted are further used for analyzing the lecture videos and thereby helping towards effective retrievals.

VII. METHODOLOGY AND RESULTS

In order to implement the proposed model, we have taken a dataset of 50lecture materials and considered 15 lecture materials for the testing purpose. Each of the YouTube videos comprised of different video lectures delivered by eminent faculty on different subjects of computer science. Each of these videos is pre-processed for the elimination of noise using Gaussian Noise Filter. Form these videos, the frames are extracted each of 2 seconds duration and all the frames are of uniform length. The data extracted from these frames are given as input to the model proposed in section 2 of the paper and the relevant PDFs are generated. Each of these PDFs is stored in the database. During the testing phase, the frames are extracted from the test video and the PDFs are computed. These PDFs are correlated with that of the existing PDFs in the database for identifying the relevant lecture videos. The comparison is carried out using KL- Divergence and thereby the relevant images retrieved are presented below in figure 2.

Figure 2: Input Lecture Video and Relevant Outputs Retrieved

A. Performance Evaluation Of Proposed Model

Estimate of retrieval performance is a critical problem in Content- Based Image Retrieval (CBIR). Various methods for calculating the performance of a system have been created and it is also used by researchers. Precision and Recall metrics are used to evaluate the performance of the developed model.

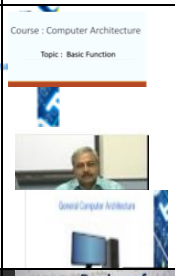
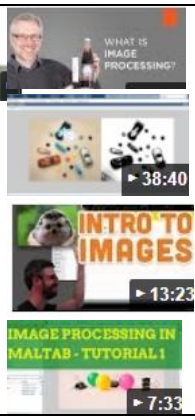
Video Lecture	Retrieved Video Lecture	Precision	Recall
		0.89	0.43
		0.91	0.52
		0.89	0.56
		0.93	0.68

Table 1: Precision & Recall Metrics

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The formulas for calculating the same are given below

$$\text{Precision} = \frac{\text{No of relevant images retrieved}}{\text{Total no of relevant images retrieved}} \quad (2)$$

$$\text{Recall} = \frac{\text{Total number of relevant images}}{\text{Number of relevant images retrieved}} \quad (3)$$

Precision measures the proportion of the total images retrieved which are relevant to the query.

VIII. CONCLUSION

In this article, a methodology based on bivariate gamma mixture model is presented for effective retrieval of relevant images from the YouTube videos. This methodology is very much useful for retrieving most relevant video images from the large datasets. The performance evaluations are carried out using precision and recall and the result shows that the proposed methodology is generating optimal results.

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