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A Mechanism for Sketch Based Image Retrievals using Generalized Gamma Mixture Model (GGMM) and Relevance Feedback Mechanism

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Abstract*: The exponential growth of multimedia technologies facilitated the ease of developing various images having different shapes and scales. With the advent of mobile technologies, these messages so generated are being transmitted across the globe in different formats for different purposes. With these advancements methodologies thus developed for identifying or expressing subjects (individuals) their views by means of sketches. These sketch based images have many advantages, in particular, these images can be well considered in situations where the narration and capturing becomes difficult. The present article underlines a mechanism to interpret the images and also addresses the retrieval of such sketch based images using Generalized Gamma Mixture Model. The relevance feedback mechanism is utilized to retrieve more relevant to sketch based images based on the query image. The efficiency of the proposed word is evaluated using metrics like precision, recall, error rate, and retrieval accuracy.

***Keywords*: Sketch-based Images, performance metrics, evaluation, precision, recall, accuracy.**

I. INTRODUCTION

With the growth of communication technologies, the usage of communication devices have been exponential and to add with the developments in transmitting speed of the interval using wireless applications and 4G technologies improved the usage rate of these technologies to its maximum. Of late there is no surprise in assuming that there is hardly a place or house where these technologies are never used. With the vast usage of these communication devices, lot of data is being generated and is being implicated and transmitted across the globe with different file formats. Therefore leading towards massive growth of data and also towards the development of unstructured data to retrieve such meaningful information from these voluminous data has become a challenging and therefore the latest technologies such as Big Data Technologies are helping to solve the issues to certain extent.

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In order to retrieve the data technologies like content based retrievals also developed and utilized in the literature [1][2][3][4][5]. However content based retrievals could be effective where the content to be retrieved can be described or presented in the meaningful manner. Methodologies like low level feature extraction, high level feature extraction ,texture extraction, semantic based interpretation extraction etc. are thus considered for the retrieval purposes of specific feature or object from the voluminous data [6][7][8][9][10]. However in particular applications where the narration could not be expressed, captured, retrieval becomes a hard core task [11][12]. Therefore in such situations sketch based images will be of vital advantage. Therefore with this intention the present article is thus considered and presented. In order to extract any image or an object, features play a dominant role. Therefore in this article we have considered relevance feedback mechanism to extract the features more authentically. In order to understand or interpret final details from the sketch based images having been generated by different artists having different mindset, strokes while generating may vary. Therefore to understand this vivid nature of the images statistical distributions will be more useful hence in this article a distribution Generalized Gamma Mixture Model (GGMM) is considered. The main advantage behind the consideration of this distribution is that it can interpret easily the images having different variations and shapes. The rest of the article is articulated as follows:

The related literature review of this area is presented in Section-2. In Section-3 dataset considered is presented. Section-4 of the paper deals with a brief insight about Generalized Gamma Mixture Model (GGMM) and its variations. In section-5 of the article relevance feedback mechanism is presented. In order to assess the efficacy of the model developed, various parameters that are considered are presented in this section of the article. The experimentation and results derived are highlighted in section-6 of the article. The concluding section-7 of the paper summarizes the article.

II. REVIEW OF LITERATURE

In this section of the article a detailed review about various articles presented by different authors and scientists is presented to showcase the status of the present work. Tianli Guo et al., (2018) published article in which the authors have tried to generate the planar shoeprint segmentation based multiplicative intrinsic component optimization.

According to the authors, it is a complex task to extract the shoeprint pattern accurately in forensic science.

In this article the authors have considered a segmentation algorithm based multiplicative intrinsic component optimization to segment the image.

Gang Lie et al.

(2018) published a paper in which the authors are proposed a method for photographic image synthesis with improved U-net. According to the authors image synthesis is complicated task with U-net due to lack of memory space for training. In this article the authors used a deep convolutional neural network, which is improved U-net (IUN). In this method the authors initially developed training set using supervised algorithm. In this article the authors used image description map with different resolutions and merged together in different layers in IUN to improve description information.

Yiping Duan et al., (2018) published article in which the authors have tried to generate the adaptive hierarchical multinomial latent model with hybrid kernel function for SAR image semantic segmentation. According to the authors, it is a complicated task to segment SAR images since SAR images contain complex structures. In this article the authors have proposed hybrid kernel function which combines Gaussian radial basis function(GRBF) and ridgelet kernel function to describe spatial relationships with central pixel and surrounding pixels. In this work an image is segregated into three different types of subspaces.

Xingyuan Wu et al., (2018) published article in which the authors have generated stroke-level sketch segmentation, which is to train machines to assign strokes with semantic part labels for a given input. The authors can take this problem as sequence-to-sequence generation problem . They have generated recurrent neural network (RNN) based model SketchSegNet to translate sequence strokes into their semantic part labels.

Siqiong He et al., (2018) published an article in which the authors have proposed system that detects embedded triangles in portrait photographs. According to the authors the problem is complicated because the triangles are not clearly defined by strait lines. In this article the authors extracted sets of line segments and used Modified Random Sample Consensus (MRSC) algorithm to fit triangles on the collection of line segments. In this paper the authors used two metrics for evaluation of fitted triangles. These are Continuity Ratio and Total Ratio. In that the authors selected high fitting scores as to detect triangles.

Yubing Li et al., (2018) published paper on Image segmentation by using Improved Grab Cut algorithm which gives better performance over Grab Cut algorithm. According to literature review of author the Grab Cut algorithm has two drawbacks one is background of the image is complex or background and object is similar in image.

Penghui Sun et al., (2018) published article in which the authors tried to develop a system for sketch Chemical Structural Formula(SCSF) recognition on smart mobile devices. In this article the authors proposed a dual-mode-based method to differentiate character inputs and non-character inputs instead of normal segmentation. An attribute graph model is used to describe the SCSF. Apart from graph model chemical knowledge is used to recognize the sketches.

Stanisław Deniziak et al., (2018) printed paper on Content Based Image Retrieval based on a sketch method. The author discussed here the main idea of the algorithm is based on composing an object into predefined set of shapes (primitives): line segments, polylines, polygons, arches, polyarches and arc-sided polygons. In this article the authors stored all the set of shapes as a graph to maintain mutual relations.

Jinjoo Song et al., (2017) published article in which the authors have tried to generate the sketch based shadow image system for digital library of images. According to the authors, it is a complex task to draw sketches accurately by the user. In this article the authors have considered different types of general images for system implementation. In this work they have considered images in all the image databases and prepared sketch features using GF-HOG. In this article the authors extracted features from input sketch and compared with sketches in the database.

Zhan Xu et al., (2017) published paper in which the authors have tried to develop a mobile game with a purpose for drawing based image retrieval (DBIR). In this paper, the authors are created a data base, which contains images for an entertaining game.

J WANG et al., (2017) published article in which the authors have tried to generate interactive pictures. According to the authors , it is a complex task since the objects may not be unique. In this article the authors have considered different types of Image Retrieval Systems like TBIR, CBIR, and SBIR.

Hraddha R Kuchekar et al.,(2017) published a paper in which the authors are proposed a system called Sketch Based Shopping. In this article the authors developed a methodology for sketch based shopping. In this system a user input a free hand sketch and this is compared with the images in the database of a web site. It retrieves a list of images similar to the sketch. A user selects the required item for shopping.

III. DATASET CONSIDERED

In order to experiment the model proposed, we have considered the dataset presented below.

IV. GENERALIZED GAMMA DISTRIBUTION

The probability density function of generalized gamma distribution is given by

$$f(x,k,c,a,b) = \frac{c(x-a)^{ck-1}e^{-\left(\frac{x-a}{b}\right)^c}}{b^{ck}\Gamma(k)}$$

Where a, b, c, k is called the Gamma variants and c, k is called shape parameters such that c, k >0. a is called location parameter, b is called shape parameter with a, b >0.

The mean of the Generalized Gamma Distribution is given by

$$\frac{a + b\Gamma\left(c + \frac{1}{k}\right)}{\Gamma(c)}$$

The variance of the Generalized Gamma Distribution is given by

$$b^2\frac{\Gamma\left(c+\frac{2}{k}\right)}{\Gamma(c)} - \left\{\Gamma(c+\frac{1}{k})/\Gamma(c)]^2\right\}$$

The mode of Generalized Gamma Distribution is given by

$$a + b(c - \frac{1}{k})^{\frac{1}{k}}, c > \frac{1}{k}$$

The rth moment about the Location parameter 'a' is given by

$$b^k(\Gamma(c + r/k) / (\Gamma(c))$$

We assume that every image as a k-component Generalized Gamma distribution and its Probability Density Function is of the form

$$h(x) = \sum_{i=1}^{k} \alpha_i \, g_i(y_i|\mu_i, \sigma_i^2, \lambda)$$

Here, λ is the skewness parameter and k is the number of regions, $\alpha_i > 0$ are weights such that $\sum_{i=1}^{k} \alpha_i = 1$ and

$$f(x,k,c,a,b) = \frac{c(x-a)^{ck-1}e^{-\left(\frac{x-a}{b}\right)^c}}{b^{ck}\Gamma(k)}$$

αi is the probability of occurrence of the ith component of the Generalized Gamma Distribution, i.e., the probability of the ith image sample. Generally, it can be taken as the ratio of the size of the ith pixel to the size of the entire image data such that,

$$\sum_{i=1}^{k} \alpha_i = 1$$

V. RELEVANCE FEEDBACK MECHANISM AND QUERY BASED RETRIEVALS

The Relevance Feedback Mechanism is utilized in this article to retrieve the images that are most relevant to sketch based images based on the query image. Each of the test to sketch based images is considered as a query image and in order to check for the similar to sketch images in the database, the query image processed and the most relevant to sketch based images are obtained using the formula given in below:

$$Q = \alpha Q + \beta\left[\frac{1}{N_R}\sum_{i=1}^{N} N_R\right] - \gamma\left[\frac{1}{N_N}\sum_{i=1}^{N} N_N\right]$$

A. Image Fusion

In order to have more relevance accuracy, the concept of fusion is considered. The sketch based images of the real time images are considered and are stored in the respective databases. The decrease in contrast affects the quality and hence affects the retrieval process [13]. Hence, it is mandate to consider the concept of fusion to elevate the contrast levels there by helping towards better edge enhancements wherein helps towards proper representation of the boundaries.

Once the object is clearly defined, its retrieval based on the query will be optimal. Hence these images which are retrieved may be of vital information in certain particular applications, such as antiques, archeological survey, to sketch based images and the corresponding treatments.

Hence in this article the concept of α -factor fusion method is utilized. Formula for obtaining the fused to sketch based images is given below:

F = (α-factor * Image1) + ((1 - α -factor)* Image2)

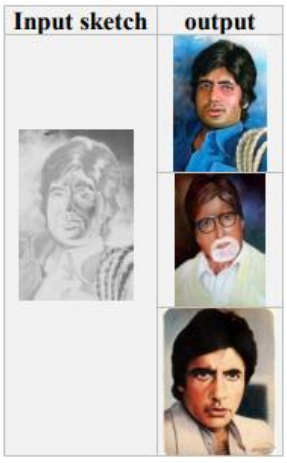
Where F is the Fused image and α is a factor that decides the fusing of the images to sketch based image such that 0< α <1.

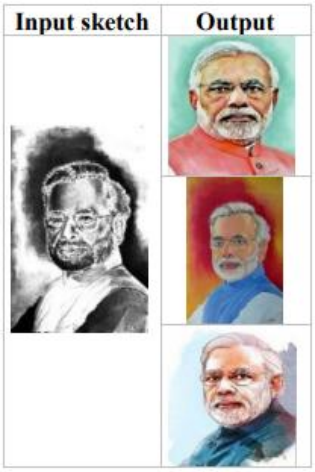
B. Sketch Based Image Retrieval Algorithm

Step 1: Obtain the most relevant features based on intensity.
Step 2: Apply these features on to the Generalized Gamma Mixture Model.
Step 3: Consider the query image and apply Relevance feedback mechanism to obtain features.
Step 4: Compute the PDF of the query image.
Step 5: Compare the relevancy.

VI. EXPERMENTATION AND RESULTS

The experimentation is conducted in Dot NET environment considering the real-time generated dataset containing 1000 different sketch based images, for the experimentation with Dataset. Among this dataset we have considered 100 sketches data as test data. The various inputs and outputs are as follows.





VII. CONCLUSION

In this article a methodology is presented to retrieve the image based on sketches. In order to extract, the features relevancy feedback mechanism is considered. The classification is carried out using GGMM algorithm. In order to retrieve more exact image the concept of fusion is introduced.

Based on the relevance of input pose more relevant to sketch based images are retrieved. The methodology is tested using the concept of fusion and also without fusion. The results developed showcase that the developed methodology could exhibit better retrieval accuracy. This method can be well suited for application of cyber forensic.

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