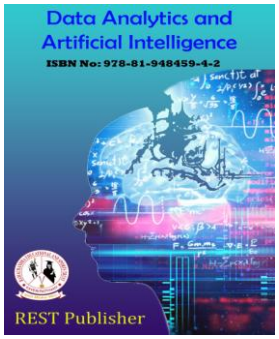
Data Analytics and Artificial Intelligence

Vol: 3(2), 2023

REST Publisher; ISBN: 978-81-948459-4-2

Website: http://restpublisher.com/book-series/daai/

DOI: https://doi.org/10.46632/daai/3/2/9



Pattern Based Image Retrieval System by Using Clustering Techniques

***[1]T. Dharani, [1]R. Kiruba Kumari, [1]B.Sindhupiriyaa, [2]R.Mahalakshmi**

[1]*Padmavani Arts & Science College for Women*, Salem, Tamil Nadu, India

[2]Vinayaka Mission Kirubananda Variyar *Engineering College, Salem, Tamil Nadu, India*

*Corresponding Author Email: drtdharani@gmail.com

Abstract. *Nowadays, the image database is growing in enormous size with heterogeneous categories. Similarly, there is rising demands from users in various ways. The most demanding domains in society are health care, Agriculture, commerce, and security. Healthcare domain is concerned with diagnosing the disease. Security domain is involved in investigation of the Criminals. Commerce domain needs analysis to recognize the right product. Agriculture domain requires processing of disease affected fruit images. The PBIR system that combines evidence from multiple digital image domains can reduce those problems of existing image retrieval systems. The PBIR system is used to find uncertain parts of the image during augmentation steps. The result is identified with various parameters (e.g., accuracy, precision, distance, sum of distance), showing that the performance of the k-medoids pam algorithm better than the existing iterative clustering algorithms.*

Keywords: *Image Retrieval System, Multi-Domain, PBIR, K-Means, K-Medoids, PAM Algorithm.*

1. INTRODUCTION

In the internet technology world, all the knowledge is taken into account as a picture format only. Because one image is adequate to thousand words. The multi-domain image database is consists of the foremost demanding fields in society are healthcare, agriculture, commerce, and security. Within the healthcare field diagnose the disease, within the security field investigate the criminals, within the commerce field to research to acknowledge the proper product and in agriculture field to seek out the disease affected fruits. The previous image retrieval systems are working with limitations like choose anyone of the fields and anyone of the image features. To beat the above limitations, the Pattern Based Image Retrieval (PBIR) system has been proposed. The PBIR system works by pattern recognition techniques. A pattern could also be a clear entity of the image. Recognition may be a label learning process. It considers mainly the patterns of the image for locating a uniform group of images from the heterogeneous image database. The heterogeneous domain image database is mammogram image, mango fruit image, trademark logo image, and face image. The grouping of the similar image in multi-domain image database by using the clustering technique. The images are grouped in some given number of clusters. Image data are grouped supported some features like color, texture, shape etc. The multi-domain image database is consists of mainly two categories are labeled and unlabeled images. During this case, the grouping of comparable images may be a very difficult task in an image retrieval system. At this example, we have proposed the k-medoids clustering techniques within the PBIR system. It is a partitioning method commonly utilized in multi-domains that need robustness to outlier data, arbitrary distance metrics. The k-medoids algorithm is to divide a group of measurements or observations into k subsets or clusters so as that the subsets minimize the sum of distances between a measurement and a middle of the measurement's cluster. Here the middle of the subset may be a member of the subset, called a medoid. This algorithm returns medoids which are the particular data points within the data set. The most reason is employed for this algorithm where the mean of the data doesn't exist within the data set. The k-medoids is beneficial for clustering categorical data where a mean is impossible to define or interpret. To solve all the above research gaps by using the next sections of the paper. Section II of this paper presents the research background of the study. Section III of this paper is that the proposed method is that the k-medoids algorithm with Partitioning Around Medoids (PAM) to PBIR system is discussed. Section IV is placing the results of processes for better understand. Section V is placing the conclusion of this paper.

2. RESEARCH BACKGROUND

The image retrieval system is used to classify the images with various classes [1]. An existing image retrieval systems are working based on text, content, shape, semantic. The Text Based Image Retrieval (TBIR) is working with the text of the image. TBIR is having demerits of efficiency, loss of information, more expensive task and time consuming. Overcome these problems by using the Content Based Image Retrieval (CBIR) system for image retrieval [2]. CBIR system working based on the features as a content of the image. The major categories of features, that is low, middle and high. Low-level features are color, texture and middle level feature is the shape and the high level feature is a semantic gap between objects. An edge detection work is finding the three parts of an image are outlines, boundaries, and background [5]. The previous image retrieval system is working with different types of image databases [3]. Nowadays, the information is transmitting in the form of pictures for better understand while reading the text. The positions, sizes, and inter relationships between objects are the features of the picture [4]. Image enhancement filters can predict the location of an image. Whether enhancements might lose their power to protect geoprivacy as the number of enhanced images in the background collection grows. In real life, there are two considerations that would impact how filtered images would accumulate in the background collection: first, the number of images that are filtered overall, and second, the number of images that are filtered with a given type of filter [6]. A grayscale image is one that has only the intensity value ranging from 0 to 1. Zero represents black and 1 represents white. An edge is a feature of an image. It is also a fundamental step in image pattern recognition, image analysis, and computer vision techniques [7]. Image segmentation work displays the portioning of a digital image [8]. The morphological operation may be a broad set of image process operations that method pictures supported shapes. In morphological operation, a structuring element is applied as an input image and creates an output image of the equal size [9]. Big Data is the advancement storage of multimedia database, which can be termed as tremendously huge sets of image feature data that may be examined computationally to reveal patterns, trends, and associations. Big data analytics refers to the process of collecting, organizing, analyzing, inspecting, cleaning, transformation and modeling large sets of data to discover patterns and other useful information [10]. To overcome the above CBIR system problems by using Pattern Based Image Retrieval (PBIR) system is a search engine for retrieving relevant images from the heterogeneous image database. The PBIR system works by pattern recognition techniques. A pattern is a visible entity of the image. Recognition is a label learning process [11]. In the trademark field, brand logo image quality is degraded by the color, texture, spatial features and using the same alteration logo, so people are affected in business. Logo due to their uniqueness, it plays a key role in e business. Because it removes the fake products in the market. The fake products are giving the wrong way to the people, for example, duplicate ATM Debit and Credit cards. The PBIR system helps product analysis to recognize the right product [12]. The K-means algorithm is mainly working with outliers of an object in the large value of the distribution of knowledge sensitive manner. Instead of taking the mean of the objects during a cluster as a point of reference, a medoid is often used, which is that the most centrally located object during a cluster. Thus the partitioning method can still be performed supported the principle of minimizing the sum of the dissimilarities between each object and its corresponding point of reference. This forms the basis of the K-Medoids method is used to segment color images [13]. The Partition Method Algorithm k medoid algorithm runs just like K-means clustering algorithm. The proposed algorithm is used systematic method of choosing the initial medoids. The performance of the algorithm may vary consistent with the tactic of choosing the initial medoids. It is more efficient than the existing k medoid. The time complexity of clustering is O (n2) time without sacrificing the accuracy of clusters [14]. The Partitioning around Medoids algorithm (PAM) has been used for performing K-Medoids clustering of the data. The results are implicational increased robustness to noise and outliers as compared to other clustering methods. Therefore the technique also can be wont to increase the general robustness of a face recognition system and thereby increase its invariance and make it a reliably usable biometric modality. K-Medoid clustering technique can help in designing sturdy face recognition systems which are invariant to the changes in pose, illumination, expression, emotions, facial distractions like makeup and hair growth etc. The real-time uncontrolled environment will always have some noise factor or variations in the face. The ability of this algorithm to deal with these unavoidable distractions in the data set encourages its use in designing robust face recognition systems [15]. The k-Medoids algorithm is more robust than k-means within the presence of noise and outliers; because a Medoid is a smaller amount influenced by outliers or other extreme values than a mean, may not terminate at the local optimum, user or programmer possible to make the change steps in implementation, it takes quadratic time complexity [16]. K-medoids algorithm modified by changing the condition factor. Largest cluster elements number is employed rather than the cluster number. The modified algorithm is applied to the database of the image of the human face with a different environment (direction, angles... etc.) [17]. K-Medoids is best in terms of execution time, non-sensitive to outliers and reduces noise as compared to K-Means because it minimizes the sum of dissimilarities of knowledge objects [18]. The parallel k-medoids algorithm here is called the PAMAE that achieves both high accuracy and high efficiency [24]. It identifies two factors “global search” and “entire data” that are essential to achieving high accuracy but also are very time consuming if considered simultaneously [19]. Here fusions of color and shape features are used for extracting the descriptors from the images through Color Moment (CM) and Edge histogram Descriptor (EDH). After that K-medoids Clustering algorithm is applied to the created dataset to obtain clusters [20]. The efficient clustering algorithm for probability density functions based on *k*-medoids [21]. It also has a high cluster accuracy compared to other distance-based partitioning algorithms for

mixed variable data [22]. The PAM algorithm is used to reduce computational time at the swap step [25]. And also PAM is parallelization of on GPU. The parallelization scheme utilizes shared memory, reduction algorithm, and optimization of the thread block configuration to maximize the occupancy [23].

3. PROPOSED METHODOLOGY

The proposed algorithm of this paper is explained in section 3. Here the multi-domain images are used for the clustering process by using Partitioning around Madrid (PAM) algorithm for improving the PBIR system.

Partitioning Around Medoids: The PAM algorithm is mainly working with the medoid. The medoid can be defined as the point in the cluster, whose dissimilarities with all the other points in the cluster is minimum. The dissimilarity of the medoid (Ci) and object (Pi) is calculated by using the following equation 1.

$$E = | Pi - Ci | \quad (1)$$

The PAM algorithm is one of the iterative algorithms which proceed in two steps. The following steps are explained in detail.

- Build-step: Each of the k clusters is associated with a potential medoid.
- Swap-step: Within each cluster, each point is tested as a potential medoid by checking if the sum of within-cluster distances gets smaller using that point as the medoid. If so, the purpose is defined as a replacement medoid.

The algorithm iterates the build- and swap-steps until the medoids don't change, or other termination criteria are met. The figure. 1 is explained the pictorial representation of proposed methodology architecture. The figure. 2 are explained the algorithm steps of proposed methodology architecture.

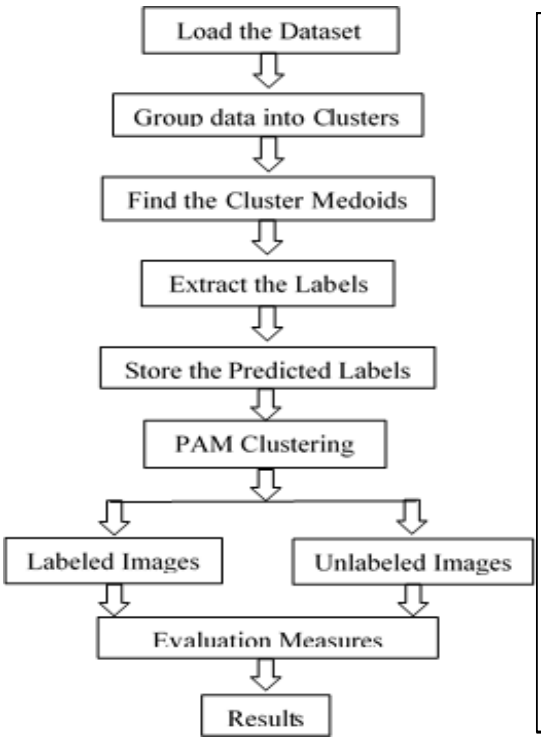


FIGURE 1. Proposed Methodology Architecture.

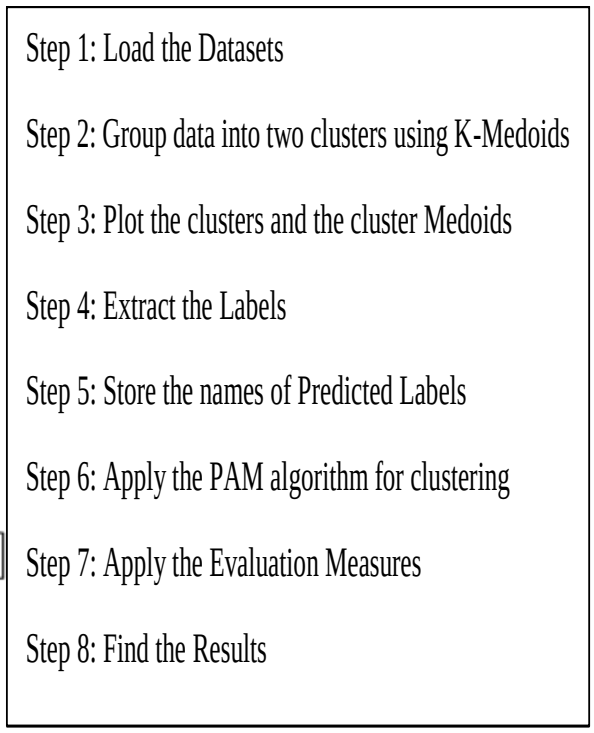


FIGURE 2. Proposed Methodology Algorithm.

4. PERFORMANCE EVALUATION

This section verifies the distance, accuracy, precision and finally confusion matrix of the proposed iterative clustering PAM algorithm.

Cluster Assignments and Medoids

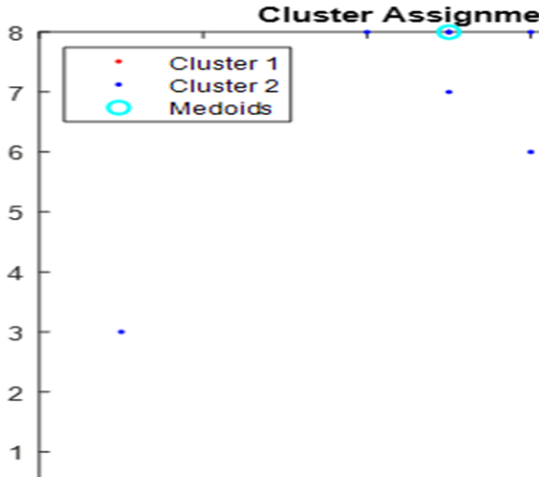


FIGURE 3. Cluster Assignments and Medoids of PAM Algorithm.

TABLE 1. The K means Mean Values for Multi Domain Images of Three Level Features.

Three Level Features	Mean		
	K=3	K=4	K=5
Color	0.4776	0.5513	0.5750
Texture	0.4365	0.5061	0.5137
Shape	0.5674	0.6071	0.6955

Evaluation Measures: The confusion matrix of a classification system contains information about the actual and predicted classifications assigned by such system.

TABLE 2. Confusion Matrix Formulas

Actual	Predicted	
	Positive	Negative
Positive	TP(True Positive)	FP(False Positive)
Negative	FN(False Negative)	TN(True Negative)

The entries in the table of confusion matrix have the following meaning:

TP- Correct classification of negative
FP- Incorrect classification of negative
TN- Correct classification of positive
FN- Incorrect classification of positive

The accuracy (AC) is the proportion of the total number of predictions that were correct.

$$\text{Accuracy} = ((TP+TN))/((TP+FP+TN+FN)) \quad (2)$$

TABLE 3. The Evaluation Measures of PAM Clustering using Three Level Features.

Three Level Features	Hamming	Sum of	Accuracy	Precision
Color	0.5	18	0.95	0.9412
Texture	1	18	0.75	0.7894
Shape	0.2857	10	0.55	0.7692

FIGURE 4. Confusion Matrix of PAM Clustering Algorithm.

In this figure 4.A, Out of 17 labeled image predictions, 94.1% are correct and 5.9% are wrong. Out of 3 unlabeled image predictions, 100% are correct and 0% is wrong. Out of 16 labeled images, 100% are correctly predicted as labeled images and 0% is predicted as unlabeled images. Out of 4 unlabeled images, 75% are correctly classified as unlabeled images and 25% are classified as labeled images. Overall, 95% of the predictions are correct and 5% are wrong.

In this figure 4.B, Out of 19 labeled image predictions, 78.9% are correct and 21.1% are wrong. Out of 1 unlabeled image predictions, 0% is correct and 100% are wrong. Out of 16 labeled images, 93.8% are correctly predicted as labeled images and 6.3% are predicted as unlabeled images. Out of 4 unlabeled images, 0% is correctly classified as unlabeled images and 100% are classified as labeled images. Overall, 75% of the predictions are correct and 25% are wrong.

In this figure 4.C, Out of 13 labeled image predictions, 76.9% are correct and 23.1% are wrong. Out of 7 unlabeled image predictions, 14.3% are correct and 85.7% are wrong. Out of 16 labeled images, 62.5% are correctly predicted as labeled images and 37.5% are predicted as unlabeled images. Out of 4 unlabeled images, 25% are correctly classified as unlabeled images and 75% are classified as labeled images. Overall, 55% of the predictions are correct and 45% are wrong.

5. CONCLUSIONS

In this paper, an efficient K-Medoids PAM Clustering Algorithm was presented for multi domain images clustering purpose and improving the PBIR system by employing three levels of image features of multi domain images. All computations were performed by using the clustering medoids is identified, cluster medoid location, cluster medoid distance, cluster assignments and medoids. The proposed technique is supported by an image clustering with the PAM algorithm. The experimental results were based on color, texture, and shape features of multi domain images. The result is identified with various parameters (*e.g.*, accuracy, precision, distance, sum of distance), showing that the performance of the K-Medoids PAM algorithm better than the existing iterative clustering algorithms.

REFERENCES

[1]. T. Dharani, I. Laurence Aroquiaraj, ―A Survey on Content Based Image Retrieval‖, IEEE 2013 International Conference on Pattern Recognition, Informatics and Mobile Engineering (PRIME), PRIME 2013, 978 1 4673 58453/13/2013.

[2]. T. Dharani, I. Laurence Aroquiaraj, ―Content based image retrieval system with modified knn algorithm‖, International Journal of Innovations in Scientific and Engineering Research (IJISER), Vol. 1 Issue 1 Jan 2014.

[3]. T. Dharani, I. Laurence Aroquiaraj, ―Content Based Image Retrieval System Using Feature Classification with Modified KNN Algorithm‖, International Journal of Computer Trends and Technology (IJCTT), ISSN: 2231 2803, volume 4 Issue 7 July 2013.

[4]. T. Dharani, I. Laurence Aroquiaraj, ―An appraisal of content based image retrieval by means of unlabelled images‖, International Journal of Advanced Research in BiologyEngineering Science and Technology, Vol. 2, Special Issue 10, March 2016.
[5]. T. Dharani, I. Laurence Aroquiaraj and V. Mageshwari, ―Comparative Analysis of Edge Detection Algorithms Based on Content Based Image Retrieval With Heterogeneous Images‖, International Journal of Computational Intelligence and Informatics, ISSN: 2349 6363, Vol. 5: No. 4, March 2016.
[6]. T. Dharani, Dr. I. Laurence Aroquiaraj and V. Mageshwari, ―Diverse Image Investigation using image metrics for Content Based Image Retrieval system‖, IEEE Xplore, August 2016.
[7]. V. Mageshwari, Dr. I. Laurence Aroquiaraj and T. Dharani, ―A Resourceful Comparison of First Order Edge Detections Using Grayscale Intensities‖, Imperial Journal of Interdisciplinary Research (IJIR), ISSN: 2454 1362, Vol 2, Issue 5, 2016.
[8]. V. Mageshwari, Dr. I. Laurence Aroquiaraj and T. Dharani, ―A Proficient Segmentation of Remote Sensing Images using Modified Kernel Fuzzy C Means Algorithm‖, International Journal of Computational Intelligence and Informatics, ISSN: 2231 0258, Vol. 6: No. 1, June 2016.
[9]. V. Mageshwari, Dr. I. Laurence Aroquiaraj and T. Dharani, ―A Realistic Medical Image Segmentation of Abnormal HIV in Blood Cells Using Morphological Operations‖, IEEE Xplore, August 2016.
[10]. V. Mageshwari, Dr. I. Laurence Aroquiaraj and T. Dharani, ―Big data in health care revolut ion a survey‖, International Research Journal of Engineering and Technology (IRJET) e ISSN: 2395 0056, p ISSN:2395 0072, Volume: 03 Issue: 09, Sep 2016.
[11]. T. Dharani, Dr. I. Laurence Aroquiaraj, ―Pattern Based Image Retrieval System built with Object Tracking and Segmentation Concepts‖, International Journal of Computer & Mathematical Sciences (IJCMS), Volume 6, Issue 9, ISSN 2347 8527, September 2017.
[12]. T. Dharani, Dr. I. Laurence Aroquiaraj, ―An Essential Image Augmentation Processes for Pattern Based Image Retrieval System‖, Elsevier's SSRN eLibrary Journal of Information Systems &eBusiness Network ISSN: 15565068, 2017.
[13]. T. Dharani, and I. Laurence Aroquiaraj. "An Automatic Image Registration Methods for Multi-Domain Images by using Geometric Relationships.",International Journal of Innovative Technology and Exploring Engineering (IJITEE), Vol. 9, Issue1, PP.No. 4053-4059, Blue Eyes Intelligence Engineering & Sciences Publication, 2019.
[14]. T. Dharani, and I. Laurence Aroquiaraj."Three Levels Of Feature Extraction From Multi- Domain Images", International Journal of Scientific & Technology Research, Vol. 8, Issue 11, ISSN 2277-8616, November 2019.
[15]. AmitYerpude, Dr. SipiDubey, "Colour image segmentation using K – Medoids Clustering," *International Journal Computer Techology& Applications*, Vol. 3(1), 2012, pp. 152-154.
[16]. Abhishek Patel, and Purnima Singh, "New Approach for K-mean and K-medoids Algorithm," *International Journal of Computer Applications Technology and Research*, Vol. 2, 1, 2013, pp. 1-5.
[17]. ArunaBhat, "K-Medoids Clustering Using Partitioning Around Medoids ForPerforming Face Recognition," *International Journal of Soft Computing, Mathematics and Control (IJSCMC)*, Vol. 3, No. 3, 2014, pp. 1-12.
[18]. T. Velmurugan, and A.Dharmarajan, "Clustering Lung Cancer Data by k-Means and k-Medoids Algorithms," *International Conference on Information and Convergence Technology for Smart Society*, Jan. 21-24, Bangkok, Thailand, 2015, pp. 17-21.
[19]. Shaker K. Ali, and ZainabNaserAzeez, "Modify k-medoids Algorithm with New Efficiency Method for Biometric Database Classification," *https://www.researchgate.net/publication/287975449*, Vol. 4, No. 10, 2015. pp. 364-376.
[20]. PreetiArora, Dr. Deepali, and ShipraVarshney, "Analysis of K-Means and K-Medoids Algorithm For Big Data," *Elsevier B.V Procedia Computer Science* Vol. 78, 2016, pp. 507-512.
[21]. Hwanjun Song, Jae-Gil Lee, and Wook-Shin Han, "PAMAE: Parallel k-Medoids Clustering with High Accuracy and Efficiency,"*https://www.researchgate.net/publication/318918153*, 2017, pp. 1087-1096.
[22]. RuchiJayaswal, JaimalaJha and Manish Dixit, "Mining of Images by K-Medoid Clustering Using Content Based Descriptors," *International Journal of Signal Processing, Image Processing, and Pattern Recognition*, Vol. 10, No. 8, 2017, pp. 135- 144.
[23]. D. Ho-Kieu, T. Vo-Van, and T. Nguyen-Trang, "Clustering for Probability Density Functions by New *k*-Medoids Method," *Hindawi, Scientific Programming*, Volume 2018, pp. 1-7.
[24]. WeksiBudiaji and Friedrich Leisch, "Simple K-Medoids Partitioning Algorithm for Mixed Variable Data," *www.mdpi.com/journal/algorithms*, Vol. 12, No. 177, 2019, pp. 1-15.
[25]. AdhiPrahara, DewiPramudiIsmi, and Ahmad Azhari, "Parallelization of Partitioning Around Medoids (PAM) in K-Medoids Clustering on GPU," *Knowledge Engineering and Data Science*, Vol. 3, No. 1, 2020, pp. 40-49.

