A Hybrid Filtering Technique of Digital Images in Multimedia Data Warehouses

Nermin Abdelhakim Othman[1], Ahmed Ayman Saad[2], Ahmed Sharaf Eldin[3]
Dept. Information Systems-Faculty of Computers and Artificial Intelligence, Helwan University, Cairo, Egypt[1]
Dept. Information System-Faculty of Informatics and Computer Science, British University in Egypt, Cairo, Egypt[1]
Dept. Information Systems-Faculty of Computers and Artificial Intelligence, Helwan University, Cairo, Egypt[2]
Dept. Information Systems-Faculty of Computers and Artificial Intelligence, Helwan University, Cairo, Egypt[3]
Dean-Faculty of Information Technology and Computer Science, Sinai University, Sinai, Egypt[3]

***Abstract*—The similarity search approach used for image Data Warehouse (DW) can provide better insights into discovering the most similar images compared to the input query. Due to the later innovation improvement, the mixed media complexity is discernibly expanded and modern inquires about regions are opened depending on comparable mixed media substance recovery. Content-Based Image Retrieval (CBIR) algorithms are utilized for the retrieval of images related to the inquiry image from gigantic databases or DW. The queries that are used for DW are complex, take a lot of time to process and many give less accurate results. For these reasons, this paper needs to have an effective technique to improve the similarity search query process that reflects a more positive result. In this paper, show how to extract features from a set of images (color, shape, and texture features) by using CBIR algorithm with Color Edge Detection (CED) method. Once these features are extracted, the proposed method will minimize the distance between these features vectors and the query image one using a Genetic Algorithm (GA). This paper illustrates the extraction of endless strong and imperative features from the database of the images, therefore, the capacity of these features in storing within the frame of features vectors. Accordingly, an imaginative closeness assessment with a metaheuristic algorithm (Genetic Algorithm (GA) with Simulating Annealing (SA)) has been attained between the query image features and those having a place in the database image. This paper introduces a new algorithm CEDF (Color Edge Detection with Gaussian Blur Filter) that applies the Gaussian Blur Filter after using CED method for feature detection of the image. Experimental results show that CEDF method gives better result than the other already-known methods.**

Keywords*—Data Warehouse (DW); Content-Based Image Retrieval (CBIR); Color Edge Detection (CED); Genetic Algorithm (GA); Simulating Annealing (SA); Memetic Algorithm (MA)

I. INTRODUCTION

A perfect image processing system relies on three vital factors; i.e. acquiring the image, transmitting the acquired image, and stretching security to the image through its transmission. This leads to defective examination of medical images while acquiring an image from the database. Therefore, this paper needs an effective method to remedy this corruption. We present a new method called CEDF. This method added a new value to the image processing process Fig. 1.

Hence, the perfect image processing system consists of three important phases: Image de-noising, image compression and image security.

A. Image Filtering

Image filtering is considered a very important phase within the image processing system. The image captured by the camera is debased by noise. That is loud image may degenerate more through the transmission process. Such a noisy image may regularly obstruct the operation of the communication system. Subsequently, it is exceptionally basic to have an effective de-noising method to evacuate noise from the image. As per noise pixel dissemination values, motivation noise is composed of two types. These types are irregular and fixed esteem motivation commotion. This commotion is called salt and pepper noise. As the noisy pixel can either have the most elevated or lowest value on grayscale [1].

B. Image Compression

As with image de-nosing, image compression is additionally an essential stage of the image processing system. The transmission and storage of crude images request huge memory space. A great compression technique with quicker processing and memory-productive compression ability fulfills the requirements of the cutting-edge image processing system. In common, compression leads to the compression of information within the advanced image. The best objective of the compression procedure is to eliminate the repetition of image information. Therefore, the computerized image will be put away more viably. Lossless and Lossy compression techniques are the two essential categories of compression procedures. In the lossless compression strategy, an image sometimes before and after compression is identical to each other. Moreover, each bit of image is put away in the decompression process. While, the lossy compression procedure, there is a contrast between the original and reproduced image. But the reconstructed image is sensibly closer to the initial image [1].

C. Image Security

The rise of the web causes extraordinary danger to data. These data are stolen through its transmission over the communication channel. Hence, the security of image

information is additionally one of the very crucial perspectives of the image processing system. Cryptography is one of the strategies utilized to supply security to data. In addition, parcel of other methods is developed to supply security to information. Sometimes parcel is not conceivable to keep the message content secured. In such a case, it is basic to keep the presence of the message as a secret. This strategy of giving security to a message is called steganography. Steganography is diverse from cryptography with reality. Cryptography bargains with keeping the message content emitted while steganography bargains with keeping the existence of the message secrete [1].

The bit-flipping mutation is a popular operator, in which a single bit in the string is flipped to form a new offspring string. A variety of other operators has also been developed, but is used less frequently (e.g., inversion, in which a subsequence in the bit string is reversed). A primary distinction that may be made between the various operators is whether they introduce any new information into the population. Crossover, for example, does not while mutation does [2].

All operators are also constrained to manipulate the string in a manner consistent with the structural interpretation of genes. For example, two genes at the same location on two strings may be swapped between parents, but not combined based on their values [3].

In this paper, the extraction of features (color, shape and texture features) will be shown from a set of images. Once these features are extracted, the method will minimize the distance between these features vectors and the query image one using GA. The paper carried out a performance test over an image dataset. Experimental result shows that CEDF results in a recall and precision raised average by 1.4 and 8.05 respectively, which assess and demonstrate the accuracy of the proposed algorithm.

This paper is organized as follows; Section II presents background related to the proposed method, Section III sheds some light on related work, Section IV speaks about the proposed algorithm, section, Section V deals with rating the performance of the proposed method, Section VI measure performance and evaluation, Section VII discusses the experiments and results, and finally, Section VIII is concluding the conclusion.

II. BACKGROUND

This paper detail the most issues related to similarity search over images in Segment 2.1. Moreover, the proposed work is based on two well-known concepts used to use in all of the research. These concepts are talking about image features and are accessible within the literature. The Omni-technique and the star-join Bitmap index are portrayed in Segments 2.2 and 2.3, separately.

A. Similarity Search

To be computationally analyzed, images ought to be pre-processed utilizing include extractors. These extractors are capable of generating features vectors that depict the natural characteristics. This preparation is elaborated as takes after. An image is spoken to as a two-dimensional m*n matrix of pixels. Where m and n are the image measurements and the pixel has numbers of values that depend on the image sort. For occurrence, the pixel values can be 0 or1 in parallel images shift between 0 and 255 in grayscale images spoken to by 8 bits and have their values within the run of 0–255 each in RGB color images. A feature descriptor is characterized by: (i) a feature extractor calculation, which tracks down the images. That feature processes their pixels values and produces number of distortions of them, and stores these values in included vectors. (ii) A distance function, which produces a similarity measure. That is utilized to decide at that point the divergence between two images based on their features vectors.

The natural characteristics of images are as a rule depicted by properties with respect to color, texture, and shape. For occurrence, feature extractors may be actualized to calculate Color Histograms [3], the Haralick descriptors [4], and the Zernike moments [3]. Color histograms speak to the conveyance of colors (or levels of gray) in an image by calculating the recurrence. In which the color intensity of each pixel happens. With respect to texture feature extractors, the Haralick descriptors are employment factual approaches. That is to determine co-occurrence networks of images such that each matrix speaks to the connection between the pixel's position and its values.

B. The Omni Technique

The Omni technique [3] is based on the choice of agent images (i.e. foci) from the DB, which is strategically positioned within the metric space. The number of representative images is given by the inborn dimensionality of the DB whereas the situating is given by the Hull of Foci algorithm. The main thought behind this calculation is to select images near the DB's borders. That can be utilized to progress probability in similarity searches.

C. The Star-join Bitmap Index

A fundamental Bitmap list [3] built on an attribute comprises of several bit-vectors. One for each esteem an of A, where the i-th bit is 1 in case the i-th push is rise to a. There is something else; the i-th bit is 0. In DW, a Bitmap list can be developed to list properties of the dimension tables demonstrating the set of tuples in a fact table. That table holds the corresponding quality values. A Bitmap list with such a plan is called the star-join Bitmap (SJB) index [3].

In this paper, the extraction of features from a set of images (color, shape, and texture features) will be cleared. That is happening by utilizing CBIR algorithms with Color Edge Detection (CED) method. Once these features are extracted, the method will minimize the removal between these features vectors and the query image one employing a genetic algorithm. This paper outlines the extraction of unending solid and basic features from the database of images. Moreover, the capacity of these features is inside the store of features vectors. In like manner, a creative closeness appraisal with a metaheuristic algorithm (GA

with SA) has been achieved between the QI features and those having a put to the database image.

III. Related Works

The related work will be divided into three directions of research that is synchronizes with the three phases of de-noising the image. The next sections will conclude the illustration of the following points:

A. Content-Based Image Retrieval, B. Image Similarity-Based Measure and C. Image de-noising.

A. Content-Based Image Retrieval

All of the previous research is important and still under research. However, no one mentioned the image as a perfect part of the source of data. Including images is vital as it improves the performance of the DW and broadband the capabilities of DW. That supports more accurate decisions for decision-makers.

A "Trigger" algorithm is used to recognize the lateness in tracking the unusual results in a large national clinical data warehouse of electronic health record (EHR) data [5]. It uses a method that upon the available data in EHR data repository from all departments of veterans' affairs healthcare facilities. This method analyzes data from seven facilities. The limitations of this research are developing and refining similar algorithms more widely. In addition, that can potentially reduce delays in diagnostic evaluation and improve the quality and safety of patient care.

In addition, there is a research depended on novel identification-based image correction method using a bi-illuminant dichromatic reflection model. That occurs by a previous awareness demonstrated by small patches with close reflection properties, called Spectrum-Shape Elements (SSE) [6]. They introduced a Hausdorff-like metric for the set of spectrum shape elements. The basic properties of these SSEs and their localization methods were proposed. The shortages of this paper are: 1) constructing SSE pairs representing prior knowledge about distortions, 2) distortion-free illumination, 3) adapting the correction technique to other image distortion sources. This technique is showing the sensor noise and pixel sampling.

The author in [7] deals with textual and non-textual features to retrieve similar images by using a novel CBIR algorithm. After that, the algorithm will classify the query image into textual or non-textual categories. In the case of the textual query images, the text is revealed and realized. For the case of visual query, outstanding qualities are detected. Both qualities merged to shape the final feature vector. In addition, through these features, the top-ranked images are retrieved.

Besides this approach is effective for textual and non-textual images, its contribution is as follows: 1) It can deal with three methods of retrievals. 2) It can deal with low-power hardware independent of training efforts. In [8] the paper is about fusing the visual and semantic similarities between the query image and the database image. Then, they use the shortest path algorithm to a weighted graph. That is for every database image node that has its pairwise similarity measure. This method was conducted on the retrieval of the common CT Imaging of Lung Diseases (CISLs). Furthermore, the results are not only better but also were more efficient. The limitations of this paper are: 1) This method can be only used in a small database but for a large database. In addition, it will consume more runtime and that requires clustering for the images. 2) This method can be only used for single-label data.

The author in [9], is proposed a new idea for the efficient retrieval of top-ranked images. That is done in the available DBs depending on local image features and spatial information in BoW architecture. To detect the performance evaluation of the proposed method, it was performed on seven state-of-the-art detectors and descriptors. After conducting this method over ten different DBs, it showed the accuracy of the proposed method. Additionally, is cleared by high precision and recall percentage record. It also proved that the proposed method exceeds the state-of-the-art detectors. As well as exceeds the descriptors over color, texture, scattered objects and complex DBs. The drawback of that method is never considering the technique scale-invariant and noise-robust.

A new content-based histopathological image retrieval approach has been proposed. This approach proposed a multi-scale and multichannel decoder based on LTP. That is to get special characteristics for every single image histogram representation. It also conducted the VLAD coding on the resultant features. Besides, power-law normalization has been performed to shape the final feature vector. By comparing the state-of-the-art techniques with the proposed approach, it shows the rising retrieval accuracy of the proposed approach. Efficiency and computational complexity are the limitations of the proposed approach [10].

This framework chooses the top-ranked images features. These features are most similar to the query image features for image retrieval. The main goal of any CBIR algorithm is to calculate the two basic descriptors (mathematical features and physical features). The main difficulties that are faced these methods are: 1) minimizing the semantic gap between the results and user expectations, 2) caring about low-level image descriptors [11].

The author in [12], is proposed a new method of Artificial Neural Networks (ANN) that joins Support Vector Machine (SVM) in a symmetric and asymmetric ways. This approach can deal with the classification inhomogeneity between various classifiers. In addition, this approach can deal with the imbalance problems in the CBIR algorithm. This method has been created because the retrieval results in multi-class search environment are so far from the expected. That is for the overlapping semantics between different classes. The experiments carried out on the Corel, Caltech-101 and COIL DBs, and proved the effectiveness of the proposed method compared to the state-of-arts methods.

The usage of the robust and consistent ETL stages in DW was better in achieving high efficiency. That is by

enhancing the preprocessing tasks. As well as, diminishing noise rates and using efficient CBIR that was better for getting top-ranked images. That is by reducing the possibilities of results and that pours into accuracy. Therefore, I will use the "Content-based" that implies the search analysis of the contents of the image. Using this approach instead of the metadata such as keywords, labels, or descriptions related to the image. The term "content" in this setting might allude to colors, shapes, textures, or any other data that can be determined from the image itself. CBIR algorithm is alluring since looks that depend simply on metadata are subordinate to comment quality and completeness.

B. Image Similarity-Based Measures

The author in [3], the Memetic algorithm is conducted to retrieve the top-ranked that is relevant to the entered query. The MA-based similarity measures do many operations. These operations are to extract an effective color, a shape and color texture features from the Corel image database. The ILS (Iterated local search) algorithm assesses the quality of the solution by raising the fitness function number. This method succeeds in increasing the average of precision and recall by 1.4 and 8.05 respectively.

One of the most achieving works is [3] and chose it to be the guide in the research. One of the most well-known metaheuristics in dealing with optimization issues could be GA. GA may be a population-based heuristic approach. GA bargains with a major framework to discover an appropriate arrangement for an uneasy issue. In addition, it has demonstrated its proficiency in producing unused arrangements between trial arrangements and recognizing the finest solutions from a populace. It is a must to have a nearby look to survey GA in finding the arrangement space. That was rather than caring approximately abusing the search space that is for improving the metaheuristic algorithm.

There are inexhaustible computer imaging applications requiring a few kinds of similarity estimation as the portion of their forms. Although the applications are much shifted and the execution subtle elements of each arrangement are special, all share the common string in those features or properties of the image (in each application). These features are measured and after that compared to other features from a database of images. In addition, these features would be compared to a few references show to extricate a few significant conclusions or usefulness approximately the image information on hand. There are a few strategies for measuring image similarity. The strategies are: 1) A pattern recognition approach. 2) Comparison of outlines in a video sequence. 3) Image stabilization employing a homographic transformation. 4) Utilizing image feature focuses to compute similarities and generate an image mosaic. Here, this paper will deal with the fourth strategy of measuring similarity search as the previous research. This paper will use this strategy because it will produce more accurate results regarded to the research of that section.

C. Image De-noising

The author in [13], Wei Wang examined a filtering method called novel inverse by employing a dictionary approach. The most thought is to combine a learned word reference for the representation of the de-convoluted image. As well as, a reverse channel based on non-negativity and bolster limitations. That is to de- convoluted the watched image with an obscure point spread function. The advantage of this approach is that the objective image can be spoken to with more points of interest by the word reference premise. This paper utilizes the substituting course strategy of multipliers (ADMM) to unravel the coming about optimization issue. The limitations are the inability to recognize the blurring data region and the support region. In this work, an image-preparing model is created, whereas an image-filtering module is created using the median channel with a variable versatile window design. This filtering provides change inters of working recurrence and PSNR. The moment stage includes the advancement of a compression module based on lifting wavelets. This compression module provides improved execution inters of compression proportion and PSNR. In the final stage, image encryption is performed to have a secured image [1]. The drawback does not use different filtering techniques to choose the best results.

Here, in [14] a new strategy presents a gradient-based approach for extracting the notable structures from diverse multimodal medical images. That is for the estimation of combination execution and consequent determination. The benefits of this strategy are showing the leading performance of visual perception joint quantitative metrics and the weakly involved calculations. The only limited point that observed here is the inactive strategy with big data. An unused de-noising approach is proposed for rebuilding the Gaussian (AWGN) noise-contaminated images. In addition, through the suggested developmentally optimized adjust Guided Image Filtering [15]. The short-come of this approach is dealing with only one type of noise (Gaussian noise). This research introduces the infrared and visible image fusion algorithm relayed on the image division of a hybrid curvature filter [16]. The limitations of this algorithm are low performance and low enhancement of the running speed.

In this research, evolving an Image Filtering and Labeling Assistant (IFLA) framework is to assist the foremost time-consuming parcel of this handle [17]. The drawbacks of this research are the inability to automatically label the marked-up ranges of images. Moreover, the inability to meet behavioral patterns and programmed individual symmetry. This paper portrays Gaussian filter and Histogram Equalization methods for de-noising and differentiates the upgrade of MR Brain images separately [18]. The suggested future work for this paper, is removing the other types of noise by using the comparing filter.

Another paper, innovates an unused filter for image boosting. This filter relayed on the combination of a shock channel with a fourth-order dissemination equation [19]. The limited result was noticed while applying this algorithm with images of degraded documents. The new

algorithm combines the versatile median filter algorithm with the conventional nonlocal mean algorithm. To begin with that, you should alter the image window and adaptively choose the comparing pixel weight. Then de-noises the image, which can have a great filtering impact on the blended noise [20]. The drawbacks of this calculation are discovering the calculation for color image processing effect and enhancing the time consumption of de-noising image.

The author in [21], point-by-point comparative investigation of diverse de-noising filtering techniques. This technique implemented leaned on four widely used Image Quality Assessments (IQA) metrics. The drawback of this paper is not diminishing more types of image noise. Lufeng Bai, et al. [22] designed a singular method for Cauchy method removal that illuminates the new demonstration. Then a rotating minimization strategy is utilized, and its merging is demonstrated. The limitation of this method is not calculating the precision and recall values to evaluate the system's efficiency.

The proposed strategy [23]' is organized utilizing three modules, to be specific. These strategies are: 1) The DIP-based module for concurrently learning noise diminishment and differentiate upgrade. 2) On the off chance that module for combining images and neutralizing color movement and noise enhancement. 3) The PR module for enhancing edge data. The drawback of this strategy is the inputs of the image fusion module can delay the velocity of the whole model. A novel variational paradigm [24] is presented based on adding up to a variety. As well as l0 the gauge for at the same time expelling the tangling noise, assessing the location of lost pixels, and filling in them. The suggested issue for enhancing the quality is using a similarity search algorithm.

All of the previous papers proposed various kinds of de-noising algorithms and strategies. Most of these used Gaussian filter lonely or a hybrid of Gaussian filter with different methods for de-noising and upgrading the performance of the targeted image. In addition, it was notable that the medical image has a dominant hand in that issue. Most of the shortcomings were from the use of one type of filtering technique in addition to low performance and running speed.

The proposed paper will introduce a new algorithm CEDF (Color Edge Detection with Gaussian Blur Filter). CEDF applies the Gaussian Blur Filter after using the CED method for feature detection of the image. Furthermore, to assess the efficiency of the system's result, will figure precision and recall values, and show the results applied to Correl DB. By contribution of the Gaussian Blur filter with the proposed method, the results were applied to Correl DB. Moreover, rising through recall and precision average 1.4 and 8.05 respectively and assess the accuracy of the result.

IV. Proposed Algorithm (CEDF)

Multimedia data play an essential role in the decision process. One of the problems when integrating multimedia data in a warehouse is the retrieval speed of the information. This information is a direct coefficient with respect to efficiency and dealing with dimensions built on information retrieval [10]. The use of DW is most common for storing/ retrieving complex data in multimedia formats. Where DBMS algorithm is traditional and is not designed to fit in handling complex multimedia data, since relational databases store structured data. That is why enhancing warehouse performance on multimedia data is essential. Because of that, this paper deals with boosting the performance of DW. That is activated by upgrading the efficiency of the algorithm with the help of promoting precision and recall results [3].

The proposed method will show how to extract features from a set of images (color, shape and texture features) by using the CBIR algorithm with Color Edge Detection (CED) method. Once these features are extracted, the method will minimize the distance between these features vectors and the query image one, using a genetic algorithm. This paper illustrates the extraction of endless strong and imperative features from the database of images. Moreover, the capacity of these features is within the store through the frame of features vectors. Accordingly, an imaginative closeness assessment with a metaheuristic algorithm (GA with SA) has been attained. This attainment is between the QI features and those having a place in the database image. Finally, the paper will measure the precision and recall of this method. By contribution of the Gaussian Blur filter with the proposed method, the results applied to Correl DB. As mentioned before that the extraction of the image features depended on three basic phases (color, shape, and texture). The paper will use the second and the third phases as it used in the previous paper [3].The enhancement of the paper only includes the color phase by using (CED) algorithm that we will enumerate in details in the following section.

A. Color Edge Detection

Edge detection is the title for a set of scientific strategies, which target classifying focuses in an image. That is because the image concentrated changes strongly or, has discontinuities. Edge detection alludes to the method of distinguishing and finding sharp discontinuities in an image. Edge detection could be a principal device utilized in most image-preparing applications. That is to get data from the outlines as an antecedent step to feature extraction and object segmentation [25]. One of the elemental errands in image-preparing is edge detection. High-level image handlings, such as object acknowledgment, division, image coding, and robot vision depends on the precision of edge detection. Whereas edges are contain fundamental image data.

Within the conventional color edge detection techniques, the color image is, to begin with, isolated into three distinctive channels. These channels are R, G, and B before handling and after that, the algorithm is connected to the particular channels. Additionally, in conclusion, all channels are combined to deliver the result. The high-level image handling applications such as question acknowledgment, protest following, robot vision, etc. In the

case of color image processing, Color images require more memory space for capacity. Unlike the greyscale, images require the transmission of color data requires a bigger transfer speed. By utilizing an effective edge discovery procedure, the unnecessary subtle elements of a color image can be disposed of. In addition, the valuable data can be put away to assist the preparation. This will successfully diminish the memory space for putting away the color data and lower the transmission bandwidth [26]. The edge discovery methods can be broadly classified as:

- Edge detection in grey-scale images.
- Edge detection in color images.

The basic distinction between a gray-scale image and a color image is the pixel in a gray-scale image may be a scalar esteemed work. While in a color image, a pixel is considered as a vector esteemed work because it comprises three-color components (red, green and blue). Due to this, vector esteemed procedures are favored for edge detection in color images [26].

1) An outline of a few classic edge detectors: Many edge detection methods have been proposed for grey-scale images in the image handling literature. These edge detectors are categorized as [26]:

- Edge detection strategies are based on the first-order subordinate.
- Edge discovery strategies are based on the second-order subsidiaries.

2) The four steps of Edge Detection

- Filtering- Filter image to move forward execution of the edge detector w.r.t noise error.
- Smoothing- stifle as much noise as conceivable, without wrecking the true edges.
- Enhancement- applies a channel to improve the quality of the edges within the image (sharpening).
- Detection- decides which edge pixels ought to be disposed of as noise and which ought to be held (as a rule, thresholding gives the basis used for detection). Localization- decide the precise location of an edge (sub-pixel resolution may well be required for a few applications. That appraise the area of an edge to better than the dispersing between pixels). Edge diminishing and connecting are as a rule required in this step. Edge discovery could be a principal apparatus utilized in most image-handling applications to get data from the outlines. Furthermore, a forerunner step includes extraction and protest segmentation [25].

B. How Does CEDF Works

Content-Based Information retrieval (CBIR) algorithm features are extracted through several techniques for the features extraction. Most visual images contain color and shape, with low-level image features and notable focuses [3]. Above all, of that, each image stores its attributes in a partitioned database called database features. A similar CBIR algorithm is outlined in Fig. 1. Here [3], is the recent paper that talked about CBIR and will reuse some steps and add another step to my new paper. On one hand the steps that will use are: (1) how to extract features from a set of images (color, shape, and texture features). (2) Once these features are extracted. (3) minimize the distance between these features vectors and the query image one using GA.

Finally, will measure the precision and recall of this method and show the results applied to Correl DB. On the other hand, we will add a new filtering technique called Gaussian Blur filtering technique with the old method. This technique concludes (RGB color with neutrosophic clustering calculation, Canny Edge strategy to extricate shape features, YCbCr color with discrete wavelet change, Canny Edge Histogram to extricate color features, and gray-level co-occurrence framework to extricate texture features). This filtering technique will raise the average precision and recall percentage and that reflects positive performance results on the proposed algorithm.

1) CEDF algorithm steps: Fig. 1 demonstrates the method suggested. The fundamental steps involved in color feature extraction are shown as follows:

- Select the image query to be processed.
- Image query and DB images will be transformed into YCbCr co; or space from the M*N input RGB image.
- Before applying the canny edge detector to the Y portion of the image, the portion of YCbCr is separated following the transformation of the image.
- After that, the unobtrusive Cb and Cr are combined with the edge that was obtained in the previous step.
- Pixel editing and the addition of CED with a noise-eliminating filtering method.
- After that, a single RGB image is created from the synthesized image.
- The histogram calculation for each portion of the RGB image is followed by the division of the RGB component into distinct R, G, and B components. From HR, HG, and HB, a total of 256 bins have been obtained.
- In each histogram that is obtained, a distinct wavelet transform is used to improve the performance of the features.to apply DWT level 3 to HG and HB and DWT level 2 to HR. There are 128 bins created when DWT is applied. In particular, 64 bins were obtained from HR, while each HG and HB obtained 32 bins.
- The repository is where each image's feature vector is calculated.
- Similarity search algorithms will elaborate to get the most similar images.
- Get the results.

The following section will illustrate the main features of (CBIR) algorithm features.

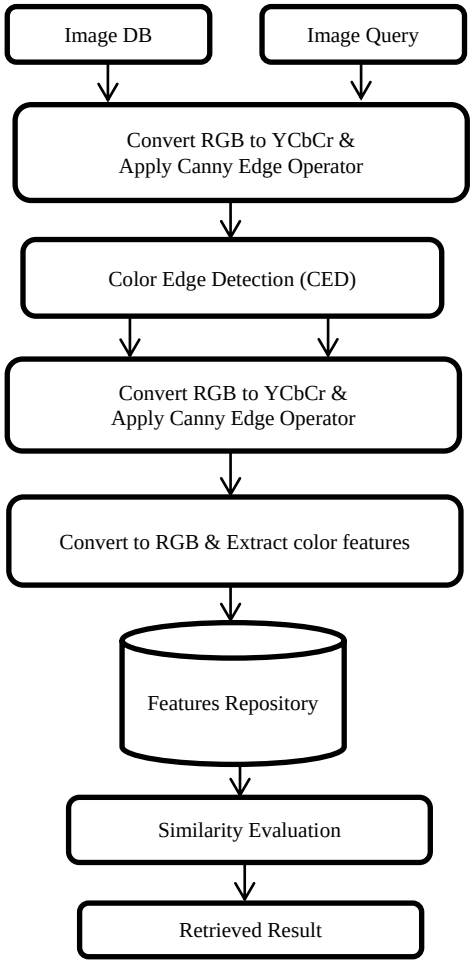

Fig. 1. The proposed method for color feature extraction.

2) Color features extraction: In this modern work, the strategy for CBIR algorithm based on the extraction of the color features, are mentioned. This strategy [3] is concluding the conversion of RGB to YCbCr and applies the canny edge detector to the result. Then will use the CED operation that is concluding the proposed filtering technique. The next sections will present the details of how to convert RGB to YCbCr, using the canny edge detector and what are the steps of CED operation.

Color is the foremost broadly utilized visual substance for image recovery. Its three-dimensional values make its separation possibility predominant to the single-dimensional gray values of images. Sometimes recently selecting a suitable color depiction, color space must be decided to begin with. Each pixel of the image can be spoken to as a point in a 3D color space.

a) Query image conversion and CED: Commonly utilized color space for image recovery incorporates RGB, Munsell, and CEDF. In the proposed paper case, the method will choose RGB and Y'CbCr spaces. Y′CbCr color spaces are defined by a mathematical coordinate transformation from an associated RGB color space. If the underlying RGB color space is absolute, the Y′CbCr color space is an absolute color space as well. Conversely, if the RGB space is ill-defined, so is Y′CbCr. The formula that allows converting RGB colors to Y'CbCr is the following:

$$[Y\ Cb\ Cr] = [RGB] \begin{Bmatrix} 0.229 & -0.168935 & 0.499813 \\ 0.587 & -0.331665 & -0.418531 \\ 0.114 & 0.50059 & -0.081282 \end{Bmatrix} \quad (1)$$

After converting the RGB to YCbCr, one should apply the canny edge detector to the result [3]. Edges in any image are helpful in identifying the objects. The new step that is added to the old method is Color Edge Detection (CED). The CED works by following these steps:

- Apply Gaussian Filter to smooth the image to remove the noise.
- Find the intensity gradients of the image.
- Apply non-maximum suppression to get rid of spurious responses to edge detection.
- Apply a double threshold to determine potential edges.
- Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

b) Conversion to RGB: After applying CED, the method reconverts the image to RGB and computes the histogram for every component (R, G and B). The color histogram serves as a viable representation of the color substance of an image in the event. That color design is one of a kind compared with the rest of the DB. The color histogram is simple to compute and successful in characterizing both the worldwide and nearby dispersions of colors in an image. In expansion, it is strong to interpretation and turns almost the seeing pivot. Moreover, the changes as it were gradual with the scale, impediment, and seeing angles.

3) Shape features: The shape of an object is an important and basic visual feature that can describe image content. In the context of content-based image retrieval, the word shape is used to refer to the geometry of a region's bounding contour in 2D. Shape feature extraction and representation are the bases of object recognition in an image. It plays an important role in many image-processing applications including content-based image retrieval. The feature extraction stage produces a representation of the content that is useful for shape matching. The easiest way to use geometric information about the objects present in an image is by computing simple scalar descriptors of the regions of interest, such as area, circularity, eccentricity, major axis orientation, dimensions of the minimum bounding rectangle, etc. Usually, the shape representation is kept as compact as possible for the purpose of efficient storage and retrieval, and it integrates perceptual features that allow the human brain to discriminate between shapes.

Finally, here are the steps followed before computing the invariant moments:

- Convert the image 2D matrix to a gray matrix.

- Apply the median blur filter on the gray matrix.
- Apply the Canny Edge detector on the filtered image.
- Generate the moments and then the Invariant moments of the image.
- Store the invariant moments in the features vector.
- Convert the image 2D matrix to a gray matrix.
- Apply the median blur filter on the gray matrix.
- Apply the Canny Edge detector on the filtered image.
- Generate the moments and then the Invariant moments of the image.
- Store the invariant moments in the features vector.

4) Texture features: Texture feature is a vital property of the image, which is often characterized as the visual appearance, or material characteristics of the objects within the image. It basically comprises the components of surface primitives (i.e., text components or textual) organized in a few indicated arrange (i.e., text format). The idea of a textual is central to the text. For the most part, it is characterized as a visual primitive that shows certain invariant properties more than once very different positions, distortion, and introduction in a given zone. The text components can be as little as a sand molecule to huge components like bricks in dividers, but they all share the comparative auxiliary and measurable properties inside a gather. The textual properties deliver rise to the seen delicacy, consistency, thickness, harshness, consistency, linearity, recurrence, stage, directionality, coarseness, arbitrariness, fineness, smoothness, granulation, etc., of the text as an entirety.

V. Performance Evaluation

A. Database Descriptions

The tests conducted in this consider utilized the Corel DB (A) comprising 1000 differing images and each image within the DB is 384 * 256 or 256 * 384 size-wise. As such, the results were expressed with the utilization of 10 semantic sets. As well, each set contains one hundred pictures. The Corel DB is of the taking after semantic categories. These categories are Mountains, Africa, Dinosaurs, Buildings, Buses, Nourishment, Elephants, Horses, Beaches, and Flowers. Consequently, with the utilization of the recorded comes about, a clear comparison of comes about can be performed.

Then the proposed paper will measure the precision and recall percentage for every category in the DB by the proposed method (CEDF). After that, the paper will compare the results with some other methods related to the topic of the paper's interest.

For that will appear the adequacy and prevalence of the proposed method in terms of recovery capabilities. Those capabilities will show by the gotten results are too compared with other algorithms in terms of precision and recall rates.

The other comparative frameworks are J. C. Felipe, Z. Mehmood, T. Mahmood, and M. A. Javid [27], N. Ali, K. B. Bajwa, R. Sablatnig, and Z. Mehmood [28], Z. Mehmood, S. M. Anwar, N. Ali, H. A. Habib, and M. Rashid [28]. Zeng, R. Huang, H. Wang, and Z. Kang [29], E. Walia and A. Pal [30], C. Wang, B. Zhang, Z. Qin, and J. Xiong [3], M. K. Alsmadi [3] and the same ten semantic sets (each set contains 100 images of Corel DB) were utilized by these comparative algorithms. Tests of diverse images from 10 semantic sets of the Corel DB appear in Fig. 1.

B. Precision and Recall Evaluation

To assess the execution and the viability of the proposed CED framework, precision and recall rates are used. Precision could be a degree of the capacity of the CED algorithm to recover. So those images will be compared to the query image. In this respect, the recall rate is the genuine positive rate, and it is utilized to assess the ability of the CED framework. That ability for regarding the number of recovered important images compared to all similar images within the database.

The precision of a CED algorithm is defined as the number of relevant images retrieved as a fraction of the total number of images retrieved [3]:

$$Precision = \frac{number\ of\ relevant\ images\ retrieved}{total\ number\ of\ images\ retrieved} \quad (2)$$

The value of Precision lies between 0% and 100%.

Another measure to find the effectiveness of a retrieval method is Recall. Recall of a CED algorithm is defined as the number of relevant images retrieved as a fraction of the total number of relevant documents in the database:

$$Recall = \frac{number\ of\ relevant\ images\ retrieved}{total\ number\ of\ relevant\ images\ in\ the\ database} \quad (3)$$

Recall values have range similar to precision, e.g., between 0% and 100%.

The recall value will be 100% if the entire database is returned as a result set in response to a query. Similarly, the precision value can be kept high by retrieving a small number of images. Therefore, precision and recall should be used together or the number of images retrieved should be specified [3].

The results of the execution of the paper's test were stated by running the proposed CED algorithm simulation five times. In every experiment, 20 inquiry images from each semantic category have been chosen arbitrarily. Then the rates of precision and recall are expressed based on the most elevated 20 images. As can be observed in Fig. 2 the exactness and review rates were calculated for 20 queries in the expansion to their recovered images. As Fig. 2 is illustrating the proposed algorithm contains a great level of effectiveness for the retrieval of images. These images were retrieved by getting higher 5 categories of precision and recall values. As the tests were demonstrating, the increment within the retrieved comparative images will move forward with precision and recall rates. The results on the extracted color, shape, and texture features

combined with the MA component. That poured in demonstrating the exceptionally empowering enhancements of the CBIR algorithm, especially regarding its recall and precision.

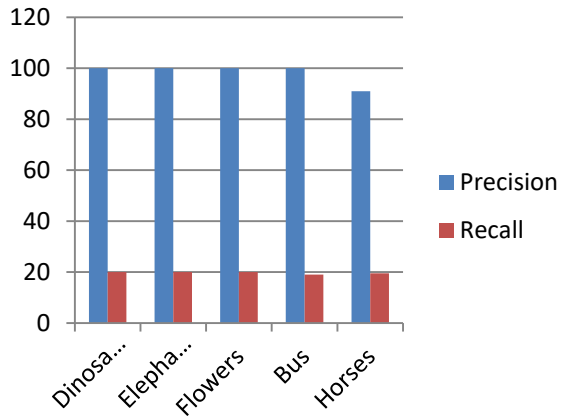

Fig. 2. Precision and recall rates of CED [3].

C. CBIR with Filters CED with /without Filters

To improve the results, should apply some filters to the original image before applying the CED algorithm. Here are the filters descriptions:

- Blur: Image blurring is achieved by convolving the image with a low-pass filter kernel. It is useful for removing noise. It removes high-frequency content (e.g. noise, edges) from the image. So, edges are blurred a little bit in this operation (there are also blurring techniques that do not blur the edges).
- Gaussian Blur: Blurs an image using a Gaussian filter.
- Median Blur: While the "Gaussian" blur filter calculates the mean of the neighboring pixels, the "Median" blur filter calculates the median.
- Laplacian: Laplacian filters are derivative filters used to find areas of rapid change (edges) in images. Since derivative filters are very sensitive to noise, it is common to smooth the image (e.g., using a Gaussian filter) before applying the Laplacian. This two-step process is called the Laplacian of Gaussian operation.

The paper used the Corel database for testing purposes. It runs the CED on 20 random query images for each class using the formula proposed in "Precision and Recall" section (Eq. 2, Eq. 3). Those will trial without adding any filtering techniques and with filtering techniques. Without filters, the recall values for the proposed (CED) method are below the average of the proposed (CED) method. That is when the Gaussian filter comparative to the other filters. For that reason, the paper will test some filters that were applied to the query image and the DB before comparing. Fig. 3 shows the recall values for some sets in Corel DB with and without filters. In addition, the results confirm that the Gaussian blur filter has better recall values than using the other different filters or without using any filters.

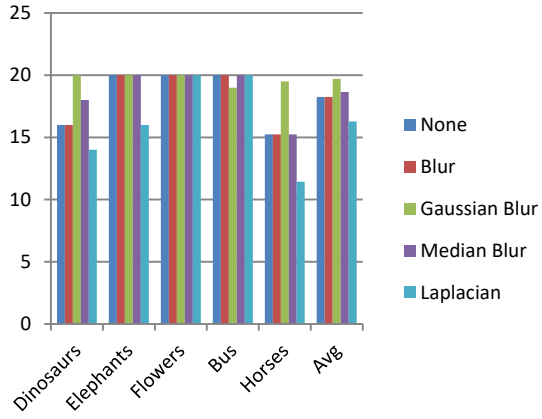

Fig. 3. Comparisons between using the CED method with and without filters (recall measure).

On one hand, Fig. 3 shows that the Gaussian Blur filter gives better results for all random proposed classes of the DB. On the other hand, the Laplacian filter gives the worst results compared to the others. Consequently, use the Gaussian blur filter with CED method to get better performance and more accurate results.

Without filters, the precision values for the proposed (CED) method are below the average of the proposed (CED) method. That is the case of the Gaussian filter compared to the other filters. For that reason, the paper tested some filters that were applied to the query image and the DB before comparing. Fig. 3 shows the precision values for some sets in Corel DB with and without filters. In addition, the results confirm that the Gaussian blur filter has better precision values than using the other different filters or without using any filters.

On one hand, Fig. 4 shows that the Gaussian Blur filter gives better results for all random proposed classes of the DB. On the other hand, the Laplacian filter gives the worst results compared to the others. Therefore, the paper use the Gaussian blur filter with CED method to get better performance and results that are more accurate.

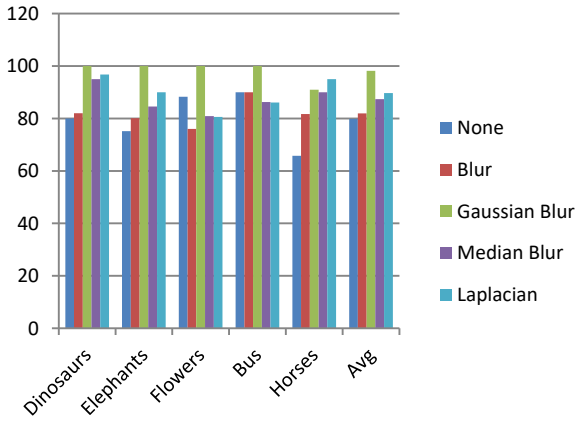

Fig. 4. Comparisons between using the CED method with and without filters (precision measure).

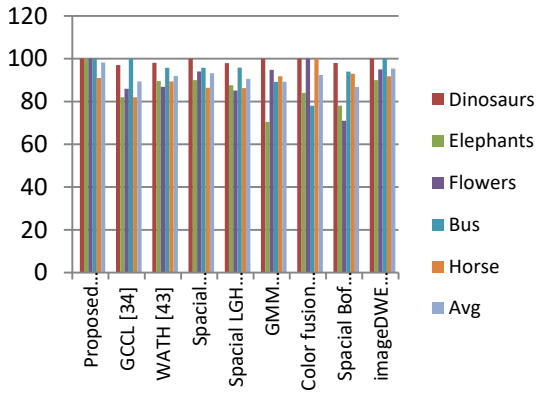

Fig. 5. Comparisons between the proposed method (CEDF) and other state-of-the-art algorithms (recall measure).

This figure shows that CEDF method gets the highest average over all the other methods. That clears especially on dinosaurs, elephants and flowers. That average is 18.31565% on the recall measure and that proves the effectiveness of the proposed method. That is when the paper compares its results to the results in Fig. 2 that proves the importance of penetrating a new filter (Gaussian filter) to the proposed method CEDF. It will be obvious from these figures (Fig. 3 & 5) that the proposed algorithm has better average recall over different points while using various methods for Corel DB.

Fig. 6 shows that the CEDF method gets the highest average over all the other methods. That average is especially on dinosaurs, elephants and flowers by scoring 100% on the precision measure. In addition, that proves the effectiveness of the proposed method. That is when the paper compares its results to the results in Fig. 2 that run the CED on 20 random query images for each class using the formula proposed in "Precision and Recall" section. This formula is without adding any filtering techniques and that proves the importance of penetrating a new filter (Gaussian filter) to the proposed method CED.

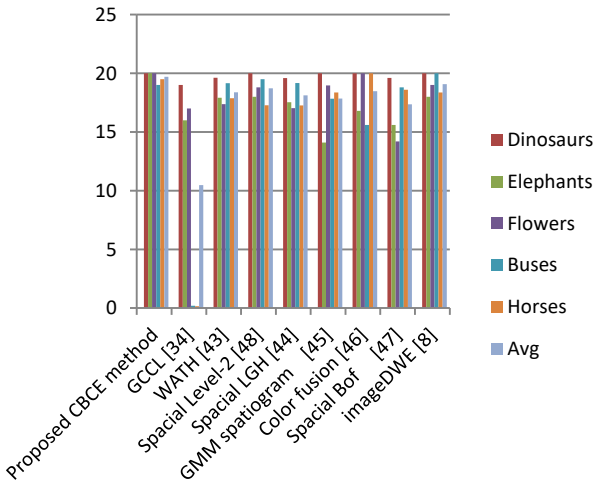

Fig. 6. Comparisons between the proposed method (CEDF) and other state-of-the-art (precision measure).

VI. Evaluation and Discussion

In this section, the paper depicts three experiments dealing with diverse images represented by diverse descriptors. For each context with and without using the filtering technique, took similarity rates to be compared. This comparison will be with each other in the two cases of using the recall and precision values.

Experiment 1: This experiment is based on examining the recall and precision rates when the paper is using different filtering techniques without using any filtering technique. The result of that experiment shows the high rates of recall and precision results. That is when the paper is using the filtering technique with the same DB and that proves the effectiveness of using a filtering technique (Fig. 3 and Fig. 4).

Experiment 2: (recall measure). This experiment depended on comparing the results of the proposed method CEDF. That experiment contains a filtering technique with the other methods of different researchers. Those researchers use the same DB but without using any filtering technique. The results of that experiment show the increasing rate of recall values by 1.4 and that proves the effectiveness of the proposed method CEDF Fig. 5.

Experiment 3: (precision measure). This experiment depended on comparing the results of the proposed method CEDF. That experiment contains a filtering technique with the other methods of different researchers. Those researchers use the same DB but without using any filtering technique. The results of that experiment show the rising rate of precision values by 8.05 and that proves the effectiveness of the proposed method CEDF Fig. 6.

The average precision and recall values of the proposed CEDF method fared better than the other cutting-edge methods, by raising the values by 8.05 and 1.4, respectively.

This is due to the fact that the other developed methods only extract a small number of features from various descriptors including shape, color, and texture. While in this work, measurements of color, shape, and texture were used to extract a large and robust number of characteristics.

Specifically, color characteristics were extracted using YCbCr color with discrete wavelet transform and Canny edge histogram, shape features were extracted using RGB color with neutrosophic clustering algorithm and Canny edge technique, and texture features were extracted using GLCM.

By raising the fitness number, the SA algorithm's combined use with GA increased the solution quality (weight). Because of this, adding the SA algorithm improved the GA's exploitation rather than its exploration of the search space. The experimental findings make it abundantly evident that the MA aids in the retrieval of a significant number of photos that are pertinent to the query image [3].

VII. Conclusion and Future Works

This study is advancement in querying unstructured medical data using a similarity search algorithm. Specifically, the contribution of this work is providing unlimited query support and efficiency in processing unstructured data in the epilepsy field. At the core of the queries are modules, which perform feature extraction from unstructured data. The framework is unlimited by adding CEDF, which has a filtering technique to erase noise and editing pixels. This filtering is done for the query image in the feature extraction phase. The framework is efficient in that it utilizes the distributed computing power of Gaussian filters.

The study shows how to extract features from a set of images (color, shape and texture features). Once these features are extracted, the minimization of the distance between these features vectors and the query image one using a genetic algorithm. Finally, we will measure the precision and recall of this method and show the results applied to Correl DB. By contribution of the Gaussian Blur filter with the proposed method, the results rising through recall and precision average 1.4 and 8.05, respectively and that assesses the accuracy of the result. As a result, such a framework is feasible and useful for medical queries. Although this study is specific to the epilepsy field, however, it is a step forward in data-driven medicine. The data-driven medicine content of the unstructured data is available for unlimited and efficient querying.

After the paper produces a concrete DW infrastructure, the next research will recommend looking into integration and usability issues.

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References

[1] S. K. Shelke, S. K. Sinha, and G. S. Patel, “Development of complete image processing system including image filtering, image compression & image security,” Mater. Today Proc., no. xxxx, 2021, doi: 10.1016/j.matpr.2021.06.154.

[2] G. Blaži, P. Poš, and D. Jakši, “Data Warehouse Architecture Classification,” pp. 1491–1495, 2017.

[3] M. K. Alsmadi, “Content-Based Image Retrieval Using Color, Shape and Texture Descriptors and Features,” Arab. J. Sci. Eng., vol. 45, no. 4, pp. 3317–3330, 2020, doi: 10.1007/s13369-020-04384-y.

[4] R. M. Hawlick, “International Conference on Computer Vision and Image Processing, CVIP 2016,” Adv. Intell. Syst. Comput., vol. 459 AISC, no. 5, pp. 1–644, 2017.

[5] D. R. Murphy et al., “Computerized Triggers of Big Data to Detect Delays in Follow-up of Chest Imaging Results,” Chest, vol. 150, no. 3, pp. 613–620, 2016, doi: 10.1016/j.chest.2016.05.001.

[6] A. Nikonorov, S. Bibikov, V. Myasnikov, Y. Yuzifovich, and V. Fursov, “Correcting color and hyperspectral images with identification of distortion model,” Pattern Recognit. Lett., vol. 83, pp. 178–187, 2016, doi: 10.1016/j.patrec.2016.06.027.

[7] S. Unar, X. Wang, C. Wang, and Y. Wang, “A decisive content based image retrieval approach for feature fusion in visual and textual images,” Knowledge-Based Syst., vol. 179, pp. 8–20, 2019, doi: 10.1016/j.knosys.2019.05.001.

[8] L. Ma, X. Liu, Y. Gao, Y. Zhao, X. Zhao, and C. Zhou, “A new method of content based medical image retrieval and its applications to CT imaging sign retrieval,” J. Biomed. Inform., vol. 66, pp. 148–158, 2017, doi: 10.1016/j.jbi.2017.01.002.

[9] K. T. Ahmed, S. Ummesafi, and A. Iqbal, “Content based image retrieval using image features information fusion,” Inf. Fusion, vol. 51, no. December 2017, pp. 76–99, 2019, doi: 10.1016/j.inffus.2018.11.004.

[10] K. N. Sukhia, M. M. Riaz, A. Ghafoor, S. S. Ali, and N. Iltaf, “Content-based histopathological image retrieval using multi-scale and multichannel decoder based LTP,” Biomed. Signal Process. Control, vol. 54, p. 101582, 2019, doi: 10.1016/j.bspc.2019.101582.

[11] K. V. Madhavi, R. Tamilkodi, and K. J. Sudha, “An Innovative Method for Retrieving Relevant Images by Getting the Top-ranked Images First Using Interactive Genetic Algorithm,” Procedia Comput. Sci., vol. 79, pp. 254–261, 2016, doi: 10.1016/j.procs.2016.03.033.

[12] A. Irtaza et al., “An ensemble based evolutionary approach to the class imbalance problem with applications in CBIR,” Appl. Sci., vol. 8, no. 4, pp. 1–26, 2018, doi: 10.3390/app8040495.

[13] W. Wang and M. K. Ng, “Dictionary-based inverse filtering methods for blind image,” Appl. Math. Model., vol. 96, pp. 269–283, 2021, doi: 10.1016/j.apm.2021.03.005.

[14] B. Goyal, D. Chyophel, A. Dogra, and V. Bhateja, “Measurement and analysis of multi-modal image fusion metrics based on structure awareness using domain transform filtering,” vol. 182, no. June, 2021, doi: 10.1016/j.measurement.2021.109663.

[15] H. Singh, S. V. R. Kommuri, A. Kumar, and V. Bajaj, “A new technique for guided filter based image denoising using modified cuckoo search optimization,” Expert Syst. Appl., vol. 176, no. March, p. 114884, 2021, doi: 10.1016/j.eswa.2021.114884.

[16] G. Liu et al., “composition,” Infrared Phys. Technol., p. 103938, 2021, doi: 10.1016/j.infrared.2021.103938.

[17] T. Xi, J. Wang, H. Qiao, C. Lin, and L. Ji, “Ecological Informatics Image Filtering and Labelling Assistant (IFLA): Expediting the analysis of data obtained from camera traps,” Ecol. Inform., vol. 64, no. June, p. 101355, 2021, doi: 10.1016/j.ecoinf.2021.101355.

[18] K. S. Reddy and T. Jaya, “Materials Today : Proceedings De-noising and enhancement of MRI medical images using Gaussian filter and histogram equalization,” Mater. Today Proc., no. xxxx, 2021, doi: 10.1016/j.matpr.2021.03.144.

[19] S. Thierry, W. Colince, N. Eloundou, and N. Alexendre, “Shock filter coupled with a high-order PDE for additive noise removal and image quality enhancement,” Array, vol. 12, no. June, p. 100105, 2021, doi: 10.1016/j.array.2021.100105.

[20] K. Huang and H. Zhu, “Image Noise Removal Method Based on Improved Nonlocal,” vol. 2021, 2021.

[21] S. M. Boby, “Medical Image Denoising Techniques against Hazardous Noises : An IQA Metrics Based Comparative Analysis,” no. April, pp. 25–43, 2021, doi: 10.5815/ijigsp.2021.02.03.

[22] L. Bai, “A new approach for Cauchy noise removal,” vol. 6, no. April, pp. 10296–10312, 2021.

[23] S. Huang, Q. Hoang, T. Le, Y. Peng, and C. Huang, “An Advanced Noise Reduction and Edge Enhancement Algorithm,” pp. 1–12, 2021.

[24] M. A. Khan, F. A. Dharejo, F. Deeba, S. Ashraf, J. Kim, and H. Kim, “Toward developing tangling noise removal and blind inpainting mechanism based on total variation in image processing blind inpainting mechanism based on total variation in image processing,” no. March, pp. 2–5, 2021, doi: 10.1049/ell2.12148.

[25] V. Banga, “Improved Color Edge Detection by Fusion of Hue , PCA & Hybrid Canny,” vol. 2, no. 1, pp. 1–8, 2015.

[26] S. Subhasini, "Color Image Edge Detection: A Survey," Int. J. Innov. Eng. Technol., vol. 8, no. 1, pp. 235–247, 2017, doi: 10.21172/ijiet.81.032.

[27] Z. Mehmood, T. Mahmood, and M. A. Javid, "Content-based image retrieval and semantic automatic image annotation based on the weighted average of triangular histograms using support vector machine," Appl. Intell., vol. 48, no. 1, pp. 166–181, 2018, doi: 10.1007/s10489-017-0957-5.

[28] Z. Mehmood, S. M. Anwar, N. Ali, H. A. Habib, and M. Rashid, "A Novel Image Retrieval Based on a Combination of Local and Global Histograms of Visual Words," Math. Probl. Eng., vol. 2016, 2016, doi: 10.1155/2016/8217250.

[29] S. Zeng, R. Huang, H. Wang, and Z. Kang, "Image retrieval using spatiograms of colors quantized by Gaussian Mixture Models," Neurocomputing, vol. 171, pp. 673–684, 2016, doi: 10.1016/j.neucom.2015.07.008.

[30] E. Walia and A. Pal, "Fusion framework for effective color image retrieval," J. Vis. Commun. Image Represent, vol. 25, no. 6, pp. 1335–1348, 2014, doi: 10.1016/j.jvcir.2014.05.005.