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Medical Image Space Classification for Disease Analysis Using PSO Optimized K- Means Clustering

Hemant Sharma, Ms. Nandini, Deepak Dixit, Rohit Singla, Praveen

M.Tech Student, Dept. of Computer Science & Engineering, Shri Ram College of Engineering and Management,
Palwal, affiliated to M.D.U Rohtak (Haryana), India

Asst. Professor, Dept. of Computer Science & Engineering, Shri Ram College of Engineering and Management, Palwal,
affiliated to M.D.U Rohtak (Haryana), India

M.Tech Student, Dept. of Computer Science & Engineering, Shri Ram College of Engineering and Management,
Palwal, affiliated to M.D.U Rohtak (Haryana), India

M.Tech Student, Dept. of Computer Science & Engineering, Shri Ram College of Engineering and Management,
Palwal, affiliated to M.D.U Rohtak (Haryana), India

M.Tech Student, Dept. of Computer Science & Engineering, Shri Ram College of Engineering and Management,
Palwal, affiliated to M.D.U Rohtak (Haryana), India

ABSTRACT: One of the principle uses of picture process is restorative picture handle in medicinal pictures to diagnose the root cause of disease. To represent these pictures additional effectively, the image space classification approach is outlined so completely different areas over the image are known severally. This approach is outlined because the content primarily based retrieval. The content extraction or the world classification is needed to spot the medical image elements. during this scheme, a good image content retrieval approach so image space identification and colorization is performed. This bestowed work is split in 3 main stages. In initial stage, the high level meta-metric is outlined persecution clump. during this work, associate degree PSO improved K-Means clustering is outlined to perform the image space classification base on intensity analysis and edge element analysis for medical images. This image space classification analysis approach is truly region primarily based classification. Simply when the high level segmentation future work performed here is that the swarm improvement to filter the result of clump method. The Swarm improvement compared the meta-metric elements in terms of worldwide and native acceptableness analysis. Throughout this scheme, the identification of unequivocal space or constituent is performed to another cluster so the efficacy of K means cluster method is obtained. Once the cluster is finished, future stage is to perform the colorization over the image that known the various medical image areas clearly using PSO. The work is verified on completely different realistically Brain pictures accessible in DICOM or jpg format. The work is enforced in matlab environs. The obtained results show the effective space classification. The analysis of the work is outlined below completely different parameters like mean analysis, STD analysis, Frequency Analysis etc.

KEYWORDS: PSO, Image space classification, Digital Imaging and Communications in Medicine (DICOM), K-means Clustering.

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I. INTRODUCTION

Medical imaging space classification is growing analysis space in previous couple of years that covers the interest of researchers of various areas like medicine, physics and computing. Medical imaging has the analysis emergence in terms of image communication, imaging modalities, image computation etc. this type of processing support administrative, clinical, teaching and analysis activity. Medical image classification has rejuvenated as new mechanism within the identification and treatment of diseases. whereas the image modalities area unit helpful, such instrumentation is dear and resource hard to please. Therefore, to cut back the workload of medical employees, automatic measurements and improved visualizations of the modality knowledge is required. One main challenge is to perform automatic analysis on medical volume knowledge is to separate numerous tissues from one another. Their boundaries is also diffused or the medical volumes area unit generally distorted by noise The content based mostly info retrieval over the medical pictures really perform the image space segmentation in order that disjoint objects or the regions over the medical image are going to be identified. The segmentation over these pictures will be performed normally approach further as underneath complicated type. This extraction is tough as a result of the accuracy is one in every of the most associated development for such quite applications. enforced in matlab environs.

Content Based Image Retrieval : In recent years with the gaining quality of world wide web it's seen that the supply of image capturing devices like scanner, digital cameras, and therefore the size of digital image information is growing chop-chop. numerous domains like drugs, design, remote sensing, research etc square measure hard for economical looking, retrieval and browsing of pictures. To meet of these sure demands the image retrieval system came into existence. Basically there square measure 2 frameworks outlined one is text-based and another one is content primarily based. In text primarily based approach, question is annotated within the text descriptors that square measure any employed by the management system to retrieve pictures. however this approach incorporates a disadvantage that is quality. to beat this content primarily based retrieval came within the early 1980's. [1]

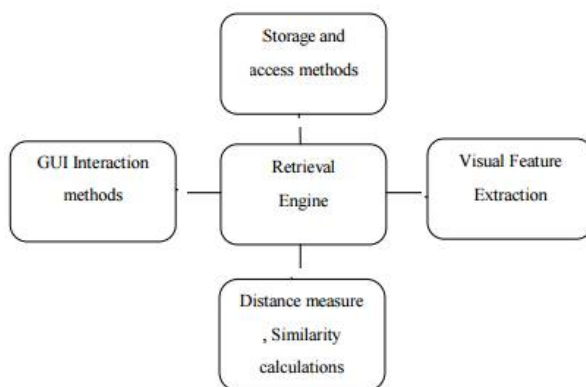


Fig. 1. The principal components of all content-based image retrieval systems.

PSO: Particle swarm optimization (PSO) is an evolutionary computation technique proposed by Kennedy and Eberhart. The basic idea of PSO is inspired by social behavior of bird flocking, fish schooling and swarm theory. One of the advantages of PSO is that it is easier to implement and there are very few parameters to adjust. PSO shares many similarities with other computation techniques such as genetic algorithm. PSO has been employed to solve a range of optimization problems, including neural network training and function minimization Particle Swarm Optimization optimizes an objective function by undertaking a population – based search. The population consists of potential solutions, named particles, which are metaphor of birds in flocks. These particles are randomly initialized and freely fly across the multi dimensional search space. During flight, each particle updates its own velocity and position based on the best experience of its own and the entire population. The various steps involved in Particle Swarm Optimization Algorithm are as follows:



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Step 1: The velocity and position of all particles are randomly set to within pre-defined ranges.

Step 2: Velocity updating – At each iteration, the velocities of all particles are updated according to below mentioned

$$v_i = v_i + c_1 R_1 (p_{i,best} - p_i) + c_2 R_2 (g_{i,best} - p_i)$$

where p_i and v_i are the position and velocity of particle i , respectively; $p_{i,best}$ and $g_{i,best}$ is the position with the 'best' objective value found so far by particle i and the entire population respectively; w is a parameter controlling the dynamics of flying; R_1 and R_2 are random variables in the range $[0,1]$; c_1 and c_2 are factors controlling the related weighting of corresponding terms. The random variables help the PSO with the ability of stochastic searching.

Step 3: Position updating – The positions of all particles are updated according to below mentioned :

$$p_i = p_i + v_i$$

After updating, p_i should be checked and limited to the allowed range.

Step 4: Memory updating – Update $p_{i,best}$ and $g_{i,best}$ when condition is met,

$$p_{i,best} = p_i \quad \text{if } f(p_i) > f(p_{i,best})$$

$$g_{i,best} = g_i \quad \text{if } f(g_i) > f(g_{i,best})$$

where $f(x)$ is the objective function to be optimized.

Step 5: Stopping Condition– The algorithm repeats steps 2 to 4 until certain stopping conditions are met, such as a pre-defined number of iterations. Once stopped, the algorithm reports the values of g_{best} and $f(g_{best})$ as its solution. PSO utilizes several searching points and the searching points gradually get close to the global optimal point using its p_{best} and g_{best} . Initial positions of p_{best} and g_{best} are different. However, using the different direction of p_{best} and g_{best} , all agents gradually get close to the global optimum.[23]

K-Means Clustering: K-means clustering algorithm is an unsupervised method. It is used because it is simple and has relatively low computational complexity. It is suitable for biomedical image segmentation as the number of clusters (k) is usually known for images of particular regions of human anatomy. K-means clustering is the most widely used and studied method among clustering formulations that are based on minimizing a formal objective function. Modification to K-means clustering method that makes

34 it faster and more efficient are proposed. It can be achieved by the clustering criteria and the unsupervised clustering- decides the clustering criteria by itself. The main argument of proposed methods is on the reduction of intensive distance computation, a simple mechanism by which at each iteration, the distance between each data points and the cluster nearest to it is computed and recorded in a data structure is suggested. Thus on the following iterations the distance between each data point and its previous nearest cluster is recomputed. [29] The steps for a standard k-means clustering algorithm are as follows.

1. Consider a set of n data points (feature vectors) to be clustered. Here the data points are the image pixels.
2. Assume the no: of clusters as k , where $2 < k < n$.
3. Randomly select k initial cluster center locations.
4. All data points are assigned to a partition defined by nearest cluster centers. This is determined by using a distance measure to check the closeness of the pixels to the chosen cluster centers.
5. After the partitioning, the cluster centers are moved to the geometric centroid of their data points in their respective partitions.
6. Repeat steps 4 & 5 until the overall objective function is smaller than a given tolerance, or until the calculated cluster centers don't move to new points.

Clustering is thought of the foremost necessary unattended learning problem; thus, as each alternative drawback of this type, it deals with finding a structure in an exceedingly assortment of unlabeled information. A cluster is thus a group of objects that square measure similar between them and square measure dissimilar to the objects happiness to alternative clusters.



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Colors- For artists, journalists and advertisers color has been the foremost effective feature and most of the photography systems use it. the colour house utilized by the photographs square measure RGB (Red, blue and green), HSV (Hue, Saturation, Value). it's seen that the majority of the photographs square measure in RGB house however this house is never used for compartmentalization and looking because it doesn't correspond to human perception as compared to alternative areas. **Texture-** the feel feature has giant selection than color house. the feel tries to capture the characteristics of a picture or the amendments within the image components with the change within the direction. This feature has shown effective ends up in case of region extraction. Classification and form Features Image segmentation is a necessary preliminary step in most automatic pictorial pattern recognition and scene analysis issues. Segmentation subdivides a picture into its constituent regions or objects, that ideally correspond to completely different real-world objects. the amount to that subdivision is dispensed depends upon the matter being resolved. In image retrieval, many systems commit to perform an automatic classification of the photographs within the assortment for feature extraction. to possess an efficient segmentation of pictures mistreatment varied image databases the segmentation method needs to be done supported the colour and texture properties of the image regions. [2] form feature is one amongst the necessary feature image options however it's not wide used as color or texture feature is employed. form feature typically deals with ratio, Fourier descriptors, Moment invariants, disk shape etc.[1] the form feature is said to segmentation. it's troublesome to use form feature as compare to paint or texture feature thanks to quality of segmentation. Despite the problem it's employed in some systems.

Classification: the method of partitioning a digital image into multiple regions (sets of pixels) is named image Classification. Actually, partitions square measure completely different objects in image that have constant texture or color. The results of image segmentation could be a set of regions that conjointly cowl the complete image, or a collection of contours extracted from the image. All of the pixels in an exceedingly region square measure similar with relevancy some characteristic or computed property, like color, intensity, or texture. Adjacent regions square measure considerably completely different with relevancy constant characteristics. Applications of Classification a number of the sensible applications of image segmentation in Medical Imaging using Image space classification :

- **Locate tumors and alternative pathologies**
- **.Measure tissue volumes**
- **Computer guided surgery**
- **Diagnosis**
- **Treatment designing Study of anatomical structures**

Medical pictures: Medical pictures play an efficient role not solely in patient identification, therapy, Surgery designing however conjointly in medical reference, coaching and analysis. the event of systems for diagnosis, screening, archiving, and expansion supported automatic analysis of medical pictures square measure relevant analysis topics. With the appearance of digital imaging modalities like single-photon emission CT (SPECT), computerized axial tomography (CT), resonance imaging (MRI) furthermore as pictures digitized from typical devices like histological slides and X-rays, collections of medical pictures is progressively being command in digital kind. [24] within the 1980's, it became clear to radiologists and therefore the makers of medical imaging instrumentality that the tremendous growth in image acquisition systems, show workstations, archiving systems, and hospital-radiology data systems created very important the property and ability of all items of apparatus. so as to alter and improve instrumentality property, medical professionals joined forces with medical 5 instrumentality makers in a global effort to develop DICOM, the Digital Imaging and Communications in medication standard. DICOM commonplace was developed to form sharing of medical data safe and specifically standardized. DICOM pictures are viewed by varied offered DICOM viewers. The oncology of those pictures rely powerfully on the feel of tissue and automatic analysis, however the medical image classification is the analysis of body structure square measure terribly essential in medical designation, it's terribly tough and it needs a substantial quantity of expertise and data. In the manual segmentation, the specialist or the MD uses his/her expertise to perform the segmentation, however once the quantity of accessible information raised, the manual segmentation becomes a troublesome process and it's turning into essential to perform it mechanically the below diagram depicts the scenario which is enforcing the existing architectural formation for providing the weight and measures for diagnostics purposes however the same is not incorporated with k-means clustering technique thus on



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performance or efficacy can be a matter of question whereas the results and execution may vary based on medical images.

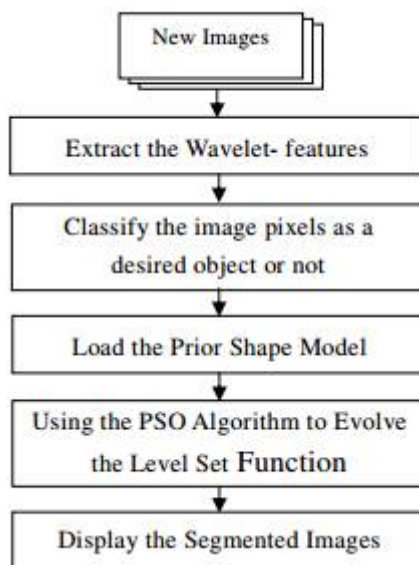


Figure 2: enforcing mechanism

II. LITERATURE REVIEW

Liu, Y. Et al. [1] proposed that in order to improve the retrieval accuracy of content based image retrieval systems, research focus had been shifted from designing sophisticated low level feature extraction algorithms to reduce the 'semantic gap' between the visual features and the richness of human semantics. This paper attempts to provide a comprehensive survey of the recent technical achievements in high level semantic-based image retrieval. Most recent publications had included in this survey covering different aspects of the research in this area including low level feature extraction, similarity measurement, and deriving high-level semantic features. Using supervised or unsupervised machine learning methods to associate low-level features with query concepts.

Henning Muller et al. [2] gives an overview of available literature in the field of content based access to medical image data and on the technologies used in the field. It gives an introduction into generic content based image retrieval and the technologies used and describes the techniques used in the implementation their datasets and evaluation. This paper also identifies explanation to some of the outlined problem with this field as it looks like many propositions for systems are made from the medical domain and research prototypes are developed in computer science departments using medical datasets. Still, there are very few systems that seem to be used in clinical practice.

B.Ramamurthy et al. [3] proposed that medical image retrieval based on shape feature, which uses canny edge detection algorithm for extraction of image shape and K-means algorithm for extraction of different regions of the image in order to improve better matching process between user query image and feature database images. We have shown that Canny Edge Detection and K-means clustering algorithms are quite useful for retrieval of relevant images from image database. V.S.V.S.

Murphy, et al. [4] proposed that Content Based Image Retrieval using Hierarchical and K-Means clustering techniques where images are initially clustered into groups having similar colour content and then the preferred group is clustered using KMeans. K-Means is a clustering method based on the optimization of an overall measure of clustering quality is known for its efficiency in producing accurate results in image retrieval.



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Dr. K. Sakthivel et al. [5] proposed modified K-means clustering algorithm to improve image segmentation accuracy and used a novel similarity distance measure where object uniqueness is considered during computation. The algorithm has been implemented and tested using 5000 general purpose images from COREL database and the retrieval performance is compared with the existing region based retrieval system. Feature extraction has been done using MATLAB image processing tool.

Zhen Ma et al. [6] proposed that for a concrete medical image segmentation task, researchers should combine the application background and practical requirements to design proper algorithms. Accuracy, complexity, efficiency and interactivity of a segmentation algorithm should all be the considered factors.

Riries Rulaningtyas and Khusnul Ain [7] defined a work of edge detection for braintumor detection. In this work Brain tumor diagnosis is done by doctors. For detecting brain tumor grading always gives different conclusion between one doctor to another. For helping doctors diagnose brain tumor grading, this research made a software with edge detections method, so it could give edge pattern of brain and brain tumor itself. Edge detection of brain tumor in this research is the first step for brain tumor grading research. This research found the best edge detection method for brain tumor detecting etween Robert, Prewitt, and Sobel method. From these three methods, Sobel method is suitable with case of brain tumors detecting. Sobel method had smaller deviation standard value than two others edge detection method.

III. RESERACH AND ELABORATION

PSO based improved K-Means Cluster: The medical space classification for disease analysis technique employed in this scheme makes use of clusters using PSO based K-Means which is associate unsupervised technique of machine learning, works well for medical pictures. Cluster will be defined as a method of organizing objects into teams whose members are similar in some way, so a cluster may be a assortment of objects that are similar between them and dissimilar to the objects and amalgamated to alternative clusters. The success of a cluster technique depends on the choice of a substantive intensity measure between the points that are clustered. There will be completely different clustering strategies based on the choice of similarity criterion that's used for bunch the objects. When distance between the information is employed it's known as distance-based cluster. If the cluster is based on any conception common to the objects it's known as abstract bunch. The selection of associate applicable similarity criterion can confirm the effectiveness of the clustering technique. Based on the approach the bunch is dispensed, there are completely different teams of PSO based K means algorithms clustering. the two basic sorts are the stratified and partitioned cluster algorithms. Hierarchical cluster may be a sequence of partitions during which every partition is nested into the next partition within the sequence. Partitioned strategies of bunch are non-hierarchical since they generate one partition of the information in a trial to recover natural teams present within the information. Both the stratified and partitioned bunch strategies will be more divided into two types like agglomerated and dissentious bunch. Agglomerated bunch starts with the different information objects placed in disjoint clusters and also the rule yield by merging the trivial clusters till one cluster results. dissentious cluster performs the same task within the reverse order beginning with the complete set of information objects collectively cluster. Another technique of classifying the bunch algorithms is as serial and coincidental clustering. Serial procedures handle the information sets one by one whereas the coincidental method works with the entire data at a time. The method that is adopted for the clustering in this work is a distance-based partitioned clustering. It uses Euclidian distance metric as the similarity criterion that guides the clustering process. Also it is a non-hierarchical method that does not find a hierarchical relation between the clusters formed. It is also a simultaneous clustering method whereas it considers the whole of the image at a time while performing the segmentation. Once the intensity analysis is over, at the next stage, the directional analysis over the image is performed using convolution filters. This is basically used to highlight the edge area so that the region based area separation will be performed. his segmentation is the combination of mathematical filters called convolution filter and morphological filters. After this stage, the complete region segmentation will be obtained. After the high level segmentation, PSO will be applied to improve the clustering outcome. This segmentation process will compare the current cluster members with other cluster members and obtain the observation under two parameters called global

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member estimation and local member estimation. If some value or the intensity value satisfy the local membership then it shows the existence of pixel or the component in particular cluster is valid. If the global membership satisfy, then the identification of the particular cluster will be done in which it actually satisfy the member. Based on this analysis, the component switching between the clusters will be done. At the final stage, the segmented area will be defined under some color model so that the colorization of different components over the image are performed. The recursive illustration of the work is given here underneath.

Proposed Model Workflow Diagram:

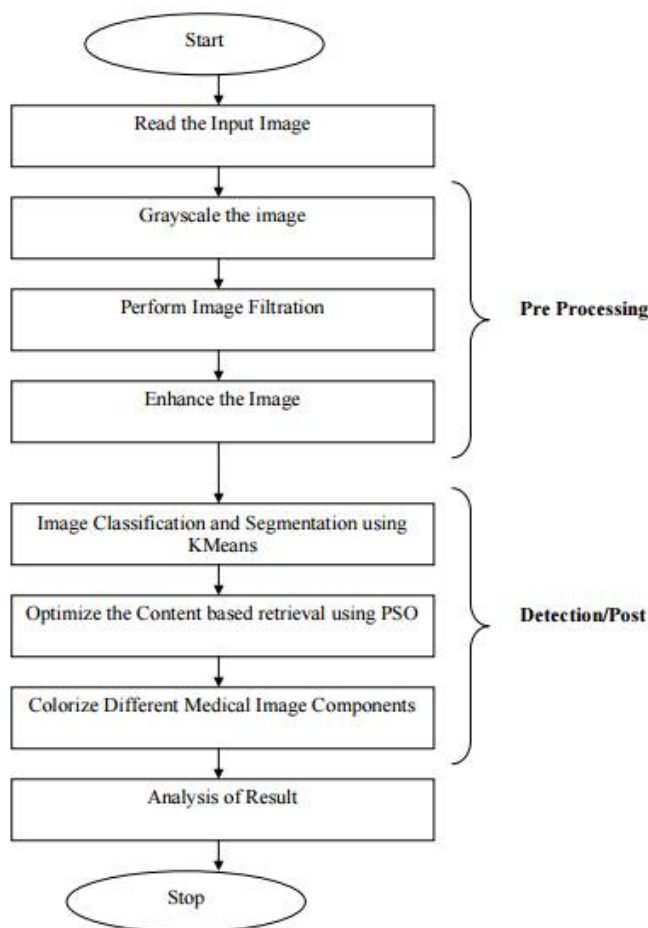


Figure 3 : Proposed Model

In the scheme the below steps explores the implementation along-with pseudo code:

1. Filter the Brain Image in terms of brightness, contrast and image size.
2. Define the Number of clusters over the Image called N clusters
3. Implement Min Max analysis over image to identify frequency range.
4. Identify Intensity Variation= Range/N
[The intensity of pixels that will change between cluster pixels]
5. For $i=1$ to N
[Process all clusters]
{



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```
6. Obtain Center for Cluster(i) called Center(i) and the relative cluster variation
}
7. Set AvgChange=MinThreshold
8. While (AvgChange<> ActualMod)
[Repeat The cluster formation till the variation over the cluster pixel is obtained]
{
9. Obtain the Segment Distance between pixel intensity and the cluster center
10. Update Variation min with minimum distance change using PSO
11. Include the pixels in different cluster based on intensity change
12. Take the Mean values to update the cluster centroids
}
}
42
13. Return ClusterList;
```

However the pseudo code s as under for ready reference and perusal :-

```
Step 1: Loading a gray scaled image Content Based Retrieval (Image)
/* Here Image is the actual medical image on which the content retrieval is performed*/
{
Image=To Gray(Image)
/*Check the image format and convert it to 8 bit grayscale image*/
Image=Adjust(Image)
/*preprocess the Image and perform the adjustment over the brightness and
contrast*/
```

Step 2: Convert the image from RGB colour space to L*a*b* colour space
Unlike the RGB colour model, L*a*b* colour is designed to approximate human vision.
There is a complicated transformation between RGB and L*a*b*.

$$(L^*, a^*, b^*) = T(R, G, B).$$

$$(R, G, B) = T'(L^*, a^*, b^*).$$

Perform the Intensity Range Analysis called MinInt and MaxInt over the image.

Step 3: Undertake clustering analysis in the (a*, b*) colour space with the K-means algorithm In the L*a*b* colour space, each pixel has a properties or feature vector: (L*, a*, b*).

Like feature selection, L* feature is discarded. As a result, each pixel has a feature vector (a*, b*).

Applying the K-means algorithm to the image in the a*b* feature space where K = 3 (by applying the domain knowledge.

Perform the intensity based clustering over the Image and divide the area in small area segment under distance based analysis.

Step 4: Label every pixel in the image using the results from K-means Clustering (indicated by three different grey levels)

Step 5. Perform the convolution filter to highlight the edge points so that region classification will be performed

Step 6. Perform Region classification over the image.

Step 7. Obtain the clusters and take it as input set for PSO.

Step 8. Perform the cluster analysis in terms of frequency and variation analysis called velocity.

Step 9. Obtain the Local Best and Global Best analysis over each segment.

For i=1 to Length(Image)

```
/*Process all area components over the Image using PSO*/
```

```
{
```

```
Dist1=Feature(i)-Local Best
```

```
Dist2=Feature(i)-Global Best
```


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```
If (Dist1<Dist2)
{
Identify the appropriate Cluster for Feature(i) and switch the clustering
Update the cluster information
Update the Local Best and Global Best Parameters
}
}
Perform the Colorization on obtained classification contents over the image
}
```

III. RESULTS AND FINDINGS

Here figure 4 is showing the input image. The figure is showing the brain image. This applicable for brain, lung or any other medical image to perform the area image space classification and colorization. The input is here taken in jpg image form.

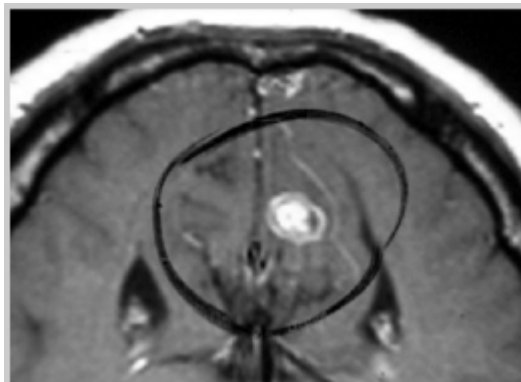


Figure 4 original gray scale medical image

Here figure 5 is showing the final output image after the colorization process. The colorization is here applied to perform the region separation so that the effective identification of component areas over the image will be done. Different components are here presented in different colors.

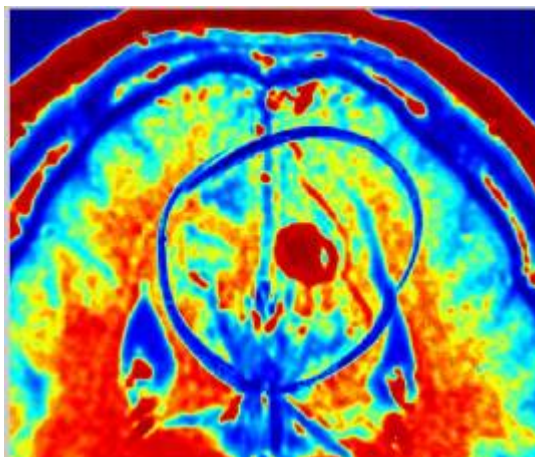


Figure 5: Colorized classified image



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Classification Analysis:-

Mean Value = 0.5000

Standard Deviation = 0.2932

Entropy Value = 5.9478

IV. CONCLUSION

In this present scheme, an effective Medical Image Space Classification for Disease Analysis using PSO Optimized K-Means Clustering approach is suggested by using hybrid three stage model. The presented model is defined with the integration of improved K-means algorithm followed by PSO based filtration approach. The presented work is defined on either medical DICOM or jpg images. These images can be brain images or the lung images. At the initial stage of work, Improved Kmeans algorithm is defined. This algorithm is based on the intensity based analysis followed by edge based analysis. This analysis is about to perform the region based segmentation over the image. At second stage, PSO is applied to perform the region filtering and switching of components. At the final stage, the color model is applied to perform the colorization. The result analysis is performed under different parameters such as frequency analysis, standard deviation analysis etc. The obtained results shows the effectiveness of the work.

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The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments.

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