A Competent Segmentation of Volcanic Eruption Flow through Volcano Using Fuzzy C-Means and Texture Segmentation Filter

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ABSTRACT

Images are imitations of factual world substances. Image can be represented in the area of digital dispensation, which can be said as another reproduction of an object. Noises are the turbulence that occurs in the image due to random dust particles. Salt and pepper noise is a noise which is mainly dependent on the intensity. When the pixels are brighter they are corrupted more. To rectify this corruption filters are used. Median filter are mainly used in the removal of the turbulence from the image because it preserves the edges from further damage. Segmentation is the process of isolating a digital image into multiple regions and retrieving useful regions for the future image analysis. The prime objective of this research work is to segment the high flow of volcanic eruption through volcano using Fuzzy C-Means algorithm and texture segmentation. Fuzzy C-Means Algorithm segments all the pixels values nearer to each other. Texture segmentation is implemented using texture filters. Local range of the image is found using texture filters. Finally range filtering exactly segments high flow of volcanic erupted area in the image.

1. INTRODUCTION:

Images are the illustration of a picture. These images can be converted to Digital form in Image Processing. Image Processing is a tactic which is used in improvising the quality and clarity of the image to get an enhanced retrieval of information. There are diverse techniques which are applied in image processing where each and every technique has its own efficiency. Noise Removal is one of the foremost techniques used in the reduction of the noises. In images noise affects the eloquence of the image which can be recovered through filtering techniques. Filtering techniques is otherwise called as the Noise removal techniques. The more resourceful filtering process is one which preserves the edges in the image and reconstructs the image in an improved manner. Median filter is one among those filters which preserves the edge[7]. Median filters are used in the removal of the useless disturbances in the image giving it a more clarity.

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Clustering technique means alignment of similar objects together. There are various types of clustering algorithms like K-means, Fuzzy C-means, Hierarchical clustering, Mixture of Gaussians. Fuzzy c-means algorithm is an overlapping algorithm which is also called the Fuzzy means algorithm. This algorithm divides the collection of data into clusters based on the specific criteria[3]. As the clusters are clustered there would be divergence in the image that is acquired. Color based image segmentation can also be processed using this algorithm. Basically texture segmentation is used to section the texture content in an image[12]. Texture analysis identifies the activities described by the silk, rough, or bumpy in the context of an image. Each behavior refers to the difference in gray levels[13]. Most commonly used texture measures are derived from the Grey Level Co-occurrence Matrix (GLCM).

2. METHODOLOGY:

Image Processing is an approach of doing incredible in a systematic way in order to get premium output. Images are the various sources for information reclamation. The following figure shows the process.
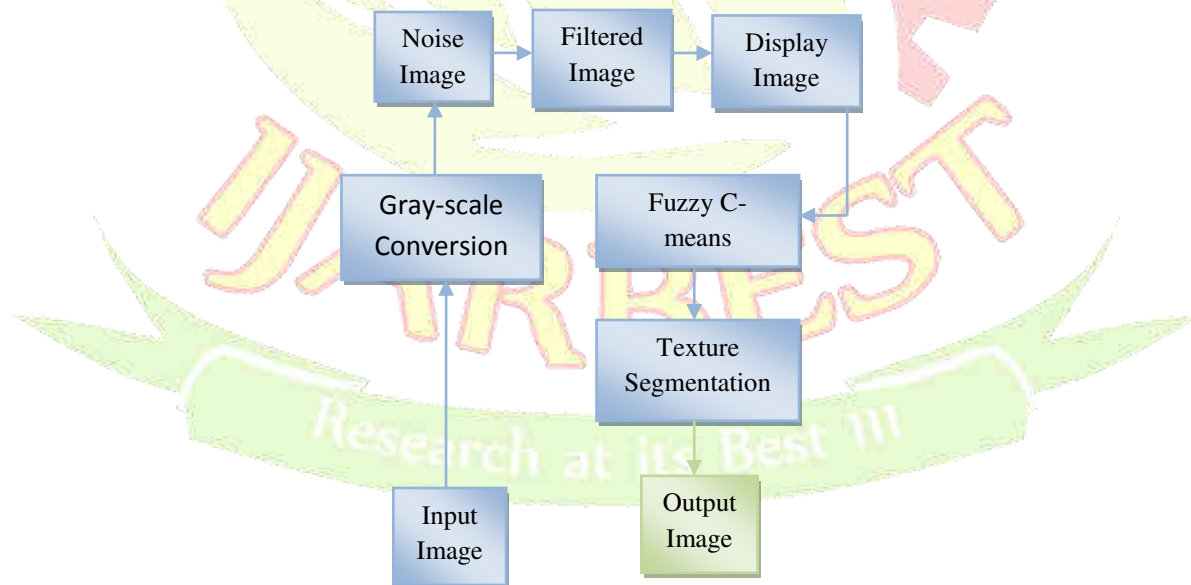

Fig1. System Architecture

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3. NOISE

Noise is an interruption which causes fluctuations in the pixel values. Hence the pixel values show random difference and this cannot be avoided. Noise can be seen in several ways. It can be divided based on the distribution of disturbances, correlation, nature and source. There are many types of noises such as periodic noise, salt-and-pepper noise, Poisson noise, and Gaussian noise.

3.1 *Salt & Pepper Noise*

In this research work salt and pepper noise is added to the image[7]. Sensors and memory problems due to the transfer of wrong maximum values of pixels is the main reason for this noise.

$$P(x) = \begin{cases} P1, & x = A \\ P2, & x = B \\ 0, & Otherwise \end{cases}$$

Where P1, P2 are the probabilities density function (PDF). P(x) is distribution of salt and pepper noise in image and A, B are the array size image.

3.2 MEDIAN FILTER:

Median filter is a sort non linear digital filtering technique which acts as a pre-processing step to enhance the processed results from an edge detection technique[6]. This filter is very effective in the removal of noise due to which the restoration of an enhanced clarity image is possible. It also conserves the edges of the image which is used in the information reclamation of the objects present in the image[7].

4. FUZZY C-MEANS ALGORITHM

Segmentation is process of partitioning the image into smaller parts. The color image segmentation is processed by Fuzzy C-Means algorithm. Fuzzy C-Means clustering process is a process in which the data belongs to more than one cluster along with the associated membership levels. This method is mainly used in the field of pattern recognition[2]. The clusters centers are updated using the formula

$$\mu_{ij} = 1 / \sum_{k=1}^{c} (d_{ij}/d_{ik})^{(2/m-1)}$$

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$$v_j = (\textstyle\sum_{i=1}^{n}(\mu_{ij})^{m}\, x_i) / (\sum_{i=1}^{n}(\mu_{ij})^{m}),$$

$$\forall_j = 1,2,\ldots..c$$

Where 'n' is the number of data points

'vj' is the jth cluster centre.

'm' is the fuzziness index m € [1,∞],

'c' is the number of cluster center.

'μij' is the membership of ith data to j^{th} cluster centre.

'dj' represents the Euclidean distance.

ALGORITHM

Let   X = {$x_1,x_2,\ldots\ldots,x_n$} is the data set points

V = {$v_1,v_2\ldots\ldots\ldots v_c$} is the set of centres.

Step 1: Cluster c is selected at random.

Step 2: Fuzzy membership is calculated using

$$\mu_{ij} = 1/\textstyle\sum_{k=1}^{c}(d_{ij}\ /d_{ik})^{(2/m\text{-}1)}$$

Step 3: calculate fuzzy center

$$v_j = (\textstyle\sum_{i=1}^{n}(\mu_{ij})^{m}\, x_i/\sum_{i=1}^{n}(\mu_{ij})^{m}),$$
$$\forall j = 1,2,\ldots..c$$

Step 4: 2 and 3 steps are repeated till   minimum   value of j is acquired.

Fuzzy algorithm fragments the images into various clusters. Fuzzy algorithm helps us to distinguish data in a more subtle manner. In each clustering we obtain diverse clustered images.

5. TEXTURE SEGMENTATION

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The usual action of Texture segmentation is to segment the texture content in an image. The texture content in the area of the image can be characterized using texture analysis[13]. The Texture analysis finds the behavior explained by the silk, rough, or bumpy in the context of an image. Each behavior refers to the variations in gray-scale levels[12]. Commonly used texture measures are derived from the Grey Level Co-occurrence Matrix (GLCM).

5.1 *Range Filter*

Local range of the image can be established by a function called rangefilt.

$$Image2=rangefilt(Image1)$$

It uses the morphological functions to resolve the maximum and minimum values in the specified neighborhood. Consequently, rangefilt uses the padding behavior of these morphological functions. It is also used to denote neighborhoods of various shapes such as disk, ball etc. Range filtering highlights the edges and surfaces.

6. RESULT

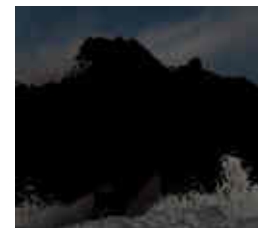#### IMAGE1

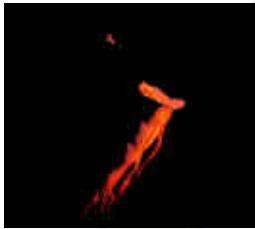   **(a) Input image**   **(b) Filtered Image**   **(c)**
     Srgb2Lab Image

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(d) Objects in Cluster Index   **(e) Objects in Cluster1**   **(f) Objects in Cluster2**

(g) Objects in Cluster3   **(h) Gray Image**   **(i) Texture Segmentation**

IMAGE2

(a) Input Image   **(b) Filtered Image**   **(c) Srgb2Lab**

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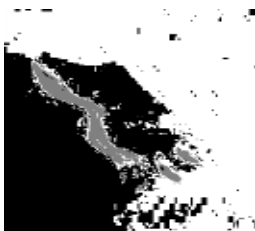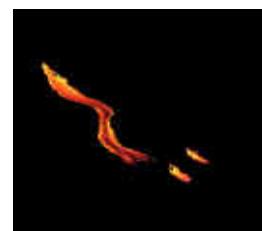
(d) Object in Cluster Index **(e) Object in Cluster 1** **(f) Object in Cluster 2**

(g) Object in Cluster 3 **(h) Gray Image** **(i) Texture Segmentation**

7. CONCLUSION

In this research work Volcano erupted image has been taken to get better segmentation of image. Traditionally conversion is one of the important processes where the respective methods are used for image modifications. Median filter is used to reduce the noise from the images. Fuzzy C-Means Algorithm segments all the pixels values nearer to each other. Finally Texture segmentation is implemented using texture filter and it exactly shows the segmentation of high flow of volcanic eruption through volcano in the images.

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