A Novel Region-Based Image Segmentation Method Using GLCM Algorithm

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Abstract.

An image is a medium to transfer information. An image includes lots of valuable information. In the technological domain of digital image, a very important task is to understand the image and extract information from the image for accomplishing some operations. Image segmentation is the initial step towards gaining the understanding regarding the image. The technique of GLCM is applied with the region based segmentation. The proposed technique is implemented in MATLAB and results are analysed in terms of certain parameters which shows high performance.

Keywords. Image segmentation, Region Segmentation, GLCM

1. INTRODUCTION

An image is a medium totransfer information. An image includes lots of valuable information. In the technological domain of digital image, a very important task is to understand the image and extract information from the image for accomplishing some operations. Image segmentation is the initial step towards gaining theunderstanding regarding the image. In fact, People generally not interested in all segments of the image. They just show interest for some certain regions withthe similar features. Image segmentation is a major hotspot in image processing and computer vision. It also provides a significant base for the image recognition. Image segmentationdepends on certain criteria for dividing an input image into a number of the similar nature of the category so that the areas appealing to people can be extracted. Image segmentation contributes significantly for image analysis and generates understanding regarding image feature extraction and recognition [1].

There are mainly two objectives of image segmentation. The first one is to decompose the image into segments for more analysis. In simple case, the environment might be reasonably well controlled with the purpose to the make the extraction possible of just those regions by segmentation process that requires further analysis. In complicated conditions thatinclude the extraction ofanoverall road network from a greyscale aerial image, it may be quite difficult to implement the segmentation process. Therefore, the application of a great deal of areafor building knowledge might be required in these conditions. Performing a change of representation is the second purpose of image

segmentation. It is essential to arrange the pixels of the image into higher-level units. These units should be either more expressive or more competent or both for advance analysis.It is imperative and at the same time complex to implement segmentation in the domain of image processing. In this process, the partitioning of an image is carried out into a number ofexpressivesegments of alike attributes. Image segmentation aims to simplify an image. This means this process presents a picture in such a way that it can be understood easily.There are many commonly used images segmentation algorithms. Some of these algorithms have been described below:

a. Threshold Method:One of the most fundamental approaches of image segmentation is threshold.In this approach, the division of data processing about grayscale image is carried out on the basis of the gray level of dissimilarobjects in direct manner.Threshold segmentation is a very popular segmentation technique in region-based segmentation algorithms. The key idea of this approach is to robotically determine the optimal threshold on the basis of a definitestandard, and usage of these pixels in accordance with the graylevel for cluster analysis. The picture that have less contrast as compared to the backdrop get treated by this approach. These approaches can be selected either manually or automatically on the basis of predefined knowledge of the picture attributes [2].

i) Local Threshold: In the local threshold approach, manifold segmentation thresholds should be selected. Once the selection takes place, this approach makes use of many thresholds for dividing the picture into many object areas and backdrops.

ii) Global Threshold: The global threshold approach makes use of a single threshold for dividing the picture into two parts comprising target and the backdrop.

The largest interclass variance method or Otsu is one of the most frequently used threshold segmentation algorithmic approach.In this algorithm, an optimal threshold is selected globally by maximizing the variance among classes. Moreover, some other well-known threshold-based approaches that are used in the integration with other techniques [3]. The threshold-based segmentation offers a major benefit of the non-complex computation and faster operational speed. Especially, it is possible to obtain the segmentation effect when both the target as well the background has high contrast. The coreweakness of this approach is that the accurate results for image segmentation problems cannot be detected easily in the absence of a noteworthy gray scale variancewithin the image. This segmentation approach showssensitivity towards noise and grayscale inconsistency as it just pays attention to the gray knowledge of the picture without taking into account the spatial image knowledge. This is the reason that this approach is generally used in combination with other segmentation approaches.

b.Region Based Segmentation Method:Region based segmentation focuses on the direct determination of the region. The keymotive of this approach is to do the classification of a particular picture into multiple regions or segments. There, it is required to determine or evaluate that a pixel within an image relates to which class [4]. At present, a number of approaches are available to perform region-based segmentation. The segmentation algorithms based on region operate in iterative manner by grouping neighbouring pixels of similar values in the same group and the pixels with different values in another group. The two popular categories of these approaches are region growing and split and merge. Both of these approaches have been described below:

i) Region growing methods: These segmentation techniques come in the category ofarchetypalsuccessive region segmentation. In these methods, the pixels with have similar features are combined together for creating a region. These methods initially make selectionof a seed pixel. After that, the similar pixels in the vicinity of the seed pixel are merged together into the locative region of the seed pixel. The key benefit of this approach isthat it generallydoes the separation of the linked areas with the alikeproperties. In this way, these methods generate satisfactory outcomes and give high quality knowledge of the image edge.

ii) Region splitting and merging methods: Split and merge is another popular approach of region-based image segmentation. The key idea of this approach is taken from quad tree data representation. In such representation, the partitioning of a square image is carried out into four quadrants in case the real image segment is uneven in terms of feature. The segmentation methods based on split and merge tries to partition a picture into even regions.

2. RELATED WORK

Yubing Li, et.al (2018) suggested an advanced algorithm which was planned on the basis of the grab cut. The efficiency and accuracy of this algorithm had demonstrated in the results of experiments. However, the time cost was increased through this algorithm [5]. The research on the association among the pixels fixed the imperfection of grab cut algorithm which was the importance of this paper. One of the difficult points for the image segmentation was the complex background. The grab cut algorithm had helped enhancing the performance in complex background using this recommended algorithm. The outcomes of experiments indicated that this algorithm had some imperfection and thus it required further enhancement in future research. In particular, the result of segmentation attained was poor if it had colourful object and the complex background.

Ozan Oktay,et.al (2018) recommended a comprehensive training approach in which a previous knowledge was integrated into CNNs using a new model that was subsequently trained successfully [6]. The novel approach persuades models that the worldwide anatomical features of the underlying anatomy were followed by them through the non-linear representations that were learnt for different shapes. The adaptation of the recommended approach was easy for various analysis tasks and it proved in this paper. The predictive accuracy of the modern models was enhanced using this approach. The multi-modal cardiac datasets and public benchmarks were employed to represent the capability of this approach. Furthermore, it was indicated that the interpretation and utilization of deep models of 3 dimensional shapes was done as biomarkers for classification of cardiac pathologies.

Haigang Sui, et.al (2017) presented a new stable shape image registration technique which was based on feature after matching the stable region with a set of rotations, scale invariant features. The matching areas were achieved using multi-scale image segmentation [7]. First of all, the images were converted into image objects through convexity model restriction and multi-scale segmentation in this algorithm. Afterward, the utilization of these reliableand steady image regions had completed as matching units instead of points and/or lines. It was indicated in the experiments that the presented algorithm was insensitive to rotations and/or resolutions distortionwhich causes the image registration accomplishment in automatic manner.

Shih-Hsiung Lee, et.al (2017) intended an image pre-processing technique for the segmentation of various parts of nail: lunula and nail plate [8]. The data representation of lunula was not clear due to poor image quality. The microscope was carried out for capturing the nail image in this paper so as the nail image quality was maintained. The images that had capture through microscope were represented the various details of the nails instead of lunula and nail plate. Demonstration of more details and the maximization of meaning related to the complexity of image processing had done in this paper. The lunula was separated from the nail plate by executing a series of image pre-processing stages at the present step. It had prominent impact was proved in the results of experiments. In the future, it would adaptable in various biometric applications.

Nishant Jain, et.al (2017) suggested a new and a different technique for automatic segmentation of diaphragm from ultrasound images. The difference in echogenicity of the diaphragm is depending on two facts included neighbouring tissues and the location of the

diaphragm in the ultrasound images. These facts were carried out in the suggested technique while segmenting the Diaphragm [9]. Various threshold values assigned with maximum and minimum intensity values available in the ultrasound image had employed in this technique for generating a set of binary images. Difference between any two threshold inputs was presented in the multiples of predetermined constant, α. The detection of all possible diaphragm which were same to curved objects had performed from each binary image at first. To end with, the exact position of the diaphragm was achieved automatically on the basis of positions of the detected objects. Fattyliver ultrasoundimages of healthy volunteers were employed for the testing of suggested technique and it was proved that this technique hadpotential for the segmentation of diaphragm from ultrasound images and obtained high precision without any help of user input.

Annegreet Van Opbroek, et.al (2019) advocated a new image weighting techniquewhich minimize the MMD between training and testing data which further assisted in the optimization of image weighting and kernel [10]. The results of experiments on hippocampus segmentation demonstrated that the performance on heterogeneous data was enhanced using the recommended methods. There was equality in the performance of earlier presented image weighting schemes and the recommended MMD. The small additional enhancement in performance had obtained when the image weighting was integrated with kernel learning optimizing whether in individual or joint way.

Tiechao Jiang, et.al (2018) focused on developing the vascular calcification segmentation process that assisted to obtain the image segmentation pre-treatment, to complete the CV model level set related to segmentation algorithm. The mathematical morphometric was implemented for processing the segmentation of an image [11]. At last, it was indicated in the outcomes of experiments that the vascular calcification image was segmented efficiently comparatively to conventional technique and the size and location of vascular calcification was achieved with accuracy through segmentation of CV model level set. The clear and smooth calcification area edge had achieved in the segmentation. In this way, an effectual basis for clinical diagnosis had obtained. However this technique was inadequate when there was a great computation. Therefore, the next work would be focused on the reduction of computational complexity. Further experiment can be done through the fusion technique [16] [17] [18] in image segmentation.

3. METHODOLOGY

This research is related to image segmentation and techniques for this purpose are generallygrouped into region based and threshold-based techniques. The region-based segmentation techniques are those which can segment the image based on the textual features of the images. The images have various type of textural features like energy, entropy etc. The threshold-based segmentation techniques are those which can segment the image into two segments. The pixels which have value above the threshold will be segmented into one segment and other into the second. Here, the region and threshold-based segmentation will be merged together to form hybrid image segmentation technique. In the proposed methodology the threshold-based segmentation techniques will be applied which can form two segments of the original image. The one segment will be proposed further and region-basedapproach will be implemented for partitioning image into N number of regions based on the pixel similarity. The phases of research work are given below:

1. Pre-processing: -The cleaning of input picture will be carried out in this stepby means of a de-noising algorithm.Also, the obtained picture will undergo more processing for the local segmentation.

2. HybridSegmentation: -This stage applies the approach of local segmentation for the image into two segments. These segments are called foreground and background. Further, the RGB scanned picture will be segmented into same and different parts by implanting the region-based segmentation. This work applied south's segmentation algorithm. A large number of benefits are provided by the segmented images obtained by this process. This work makes use of a gray scale image for threshold. The conversion of RGB image is carried out into binary image. The image achieved by this process is in B&W format. In the next step of feature extraction, the features are extracted by implementing GLCM. This algorithm is used in this work just for the extraction of texture attributes. This algorithm takes out total thirteen image attributes so that the tumor can be detected.

- Energy: This parameter computes how many times the pixel pairs are repeated. It computes the evenness of a picture. In case of extremely tiny pixels, the energy level will be big.

  Energy = $\sqrt{\sum_{i,j=0}^{N-1} p_{i,j}^2}$ (1)

- Entropy: Entropy measures the average information content in every source sign.

  Entropy=$\sum_i p_i log_{\dot{x}} i$ (2)

- Contrast: This parameter measures the brightness of a pixel and its neighbour in the picture. The difference in the colour and intensity of the object and other objects w.r.t to the similar field is measured in the realistic manner.

  Contrast=$\frac{I_{max}-I_{min}}{I_{max}+I_{min}}$ (3)

K-Mean is a popular region-based segmentation approach. The k-mean segmentation technique will segment input image into certain classes based on the GLCM factors.

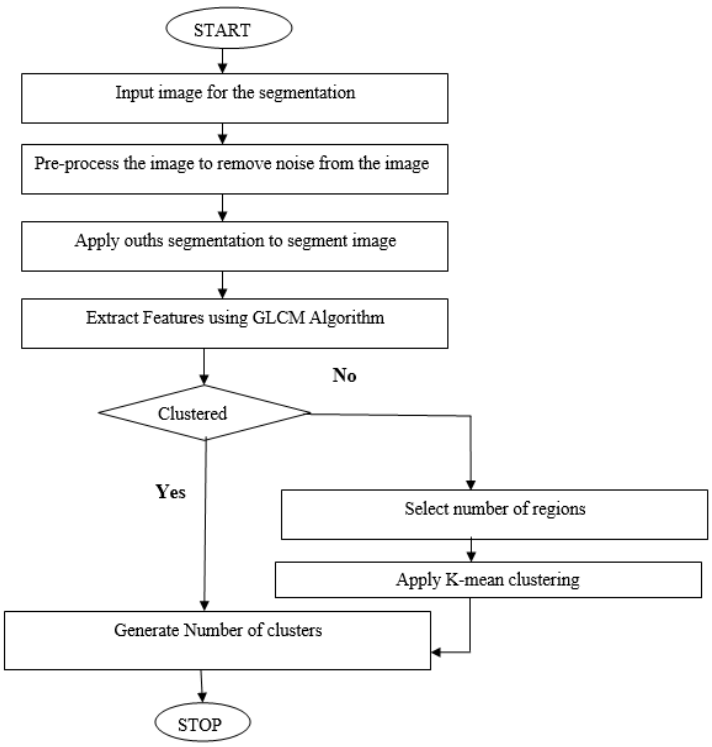

Figure 1. Experimental Flowchart

4. RESULTS AND DISCUSSION

The American Psychopathological Society demonstrates several thousand of technically peer-reviewed pictures presenting infection indications, pests, and other anarchies related to the crops and plants by its books and journal-issuing plans. APS images are beneficial for education and training purposes. Over these many years, APS figure has been available via APS PRESS slide suites, record tools, picture CDs, and these days by the online APS picture record. The pictures involving subtitles during their availability together with supplier/photographer identification and credentials are also discoverable. The APS picture folder is assisted through the APS PRESS Editorial Board and is possible to stiff into tens of thousands of infection, nuisance, and chaos pictures obtainable on Net.

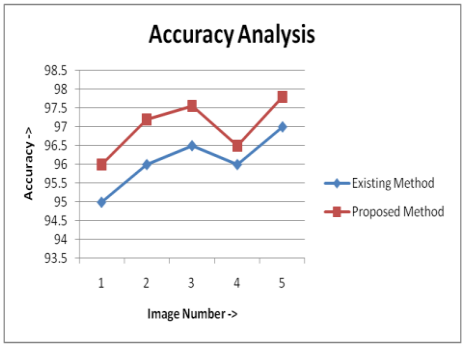

Figure 2. Accuracy Analysis

Figure 3. Execution Analysis

Figure 2 shows the accuracy-based comparison amid the existing and proposed technique. The accuracy of new technique for the segmentation is analysed in this figure. Figure 3 shows execution time-based comparison amid the new and earlier technique. The execution time of new technique is low than the earlier technique.

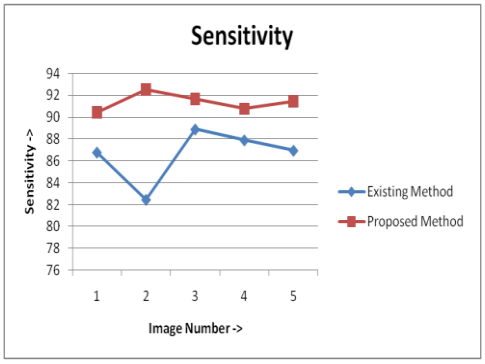

Figure 4. Sensitivity Analysis

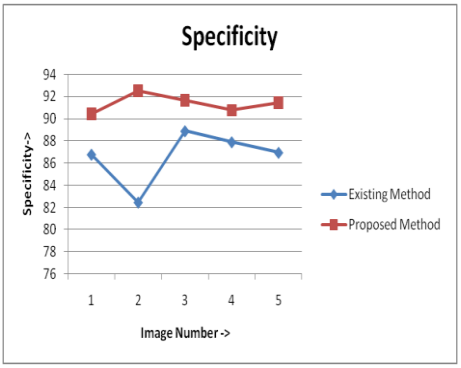

Figure 5. Specificity Analysis

Figure 4 shows the sensitivity based comparison amid the new and earlier technique. The sensitivity of proposed technique for the segmentation is analysed in this figure. Figure 5 shows the specificity-based comparison amid the existing and proposed technique. The specificity of new technique for the fruit quality prediction is analysed in this figure.

5. CONCLUSION

The technique used for the improvement of unprocessed or raw pictures is called imageprocessing. The image capturing tools installed on different objects can click images

for multiple applications. These images are mostly rough in nature. Over the time, researchers have devised various image processing algorithms.It is required to convert an image clicked by an image capturing tool into a suitable format prior to carry out any sort of image processing. Image segmentation comes at the second place in image processing. This work implements k-mean segmentation for segmenting the pre-processed image. The region-based segmentation will segment the data dependent on the taken-out features using GLCM algorithm. The performance of existing and proposed algorithms is analysed with regard to several metrics. The analytic outcomes reveal that new algorithm performs superior than the earlier algorithmic approach

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