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GENETIC ALGORITHM BASED ANALYSIS OF RIGID AND NON RIGID MEDICAL IMAGES

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Abstract- *Image segmentation is the process of partitioning a digital image into multiple segments also known as super pixels. The proposed work mainly relies on the genetic algorithm based concepts. Genetic algorithm is an optimization technique which is performed based on the fitness function criteria. By undergoing maximum number of iterations the result is been obtained. The chromosomal abnormalities can be easily identified with the help of its structure. The chromosomal analysis was performed over the meta-spread chromosome images. Chromosomal overlapping and the touching are the problems in meta-spread image. So the segmentation of the chromosomal structures helps in reducing those abnormalities. The proposed work is to segment the overlapping chromosome images based on the genetic algorithm. The genetic algorithm is an optimization technique that helps in optimizing the energy function which further improves the segmentation accuracy. Due to the non- rigid shape of the chromosome images they can be overlapped or touched with other chromosome images during cell division. Thus for the chromosome analysis the segmentation of overlapping chromosome is required. The regions where the overlapping is more is shown using majority color based on the genetic algorithms worst case, best case and average case concept the best case is identified as the overlapping region in the chromosome image. The mask1 and mask2 are created for the image based on its center and radius .The masks helps in determining the overlapping zones in an image. Finally the cropped image helps in identifying the overlapping regions*

Key Words: Genetic algorithm, chromosomes, contour detection, overlapping region, Fitness function

1. INTRODUCTION

Chromosomes are the packed genetic material that contains the DNA and protein sequences. Chromosomes carries the heredity information from generation to generation. Chromosomes suppress the characters from parents to the offspring's. Certain birth defects normally occur due to chromosomal abnormalities. Thus the diagnosis of chromosomal abnormalities plays a vital role in preventing certain genetic disorders. The chromosomal abnormalities can be easily identified with the help of its structure. The chromosomal overlapping and the touching position determines that the chromosomes are in a diseased state. So the segmentation of the chromosomal structures helps in reducing those abnormalities. The chromosomal abnormalities normally occur during the cell division so its segmentation plays a vital role in diagnosis purpose. Genetic Algorithm is a search technique to find approximate solutions to optimization and search problems by using the genetics as its model of problem solving. Its usefulness and gracefulness of solving problems has made it the more favorite choice among the traditional methods, namely gradient search, random search and others[1]. one chromosome can contain a whole image or only a small part of it, a whole parameter range or only the most descriptive ones. Crossover can be performed in various manners, for example by exchanging information at one brake point or at several one. Different strategies may be used for genetic information transfer and parallel evolution may be adopted[2]. Karyotype analysis is a widespread procedure in cytogenetics to assess the possible presence of genetic defects[6]. The average accuracy rate of segmentation of the Robert's method is 97.69%, which is very close to Canny's method of 96.54%[5].

1.1 Chromosomal Segmentation

A chromosome is a packaged structure containing DNA of a living organism. It is not usually found on its own, but rather is structured by being wrapped around protein complexes called nucleosomes. Which consist of proteins called histones. The overlapping and touching of the chromosomes usually occurs during the cell division and hence results in certain abnormalities like Down syndrome, Edwards syndrome, turner syndrome etc. Hence the segmentation helps in minimizing these chromosomal abnormalities, this segmentation carried out on the basis of genetic algorithm, is carried out on the

basis of genetic algorithm, which is an evolutionary algorithm and is an optimization technique which helps in optimizing the energy function to get better segmentation results. Here the contrast regions in the image are chosen as the fitness based on the intensity values and the segmentation is carried out.

1.2 Overlapping/Touching Region Identification

The overlapping and touching of the chromosomes usually occurs during the cell division and hence results in certain abnormalities like Down syndrome, Edwards syndrome, Turner syndrome etc. Hence the segmentation helps in minimizing these chromosomal abnormalities. Hence this segmentation is carried out on the basis of genetic algorithm, which is an evolutionary algorithm and is an optimization technique which helps in optimizing the energy function to get better segmentation results. Here the contrast regions in the image are chosen as the fitness function based on the intensity values and then the segmentation is carried out.

1.3 Genetic Algorithm

The genetic algorithms are the most powerful unbiased optimization techniques for sampling a large solution space. They were applied for the image enhancement, segmentation, feature extraction and classification as well as the image generation. This explains the increasing popularity of GAs applications in image processing and other fields. They are used where exhaustive search for solution is expensive in terms of computation time. Applications of GAs for image processing extend from evolving filters or detecting edges to making complex decisions or classifying detected features. The aim of this article is to review GA applications for the most fundamental image processing tasks image enhancement and image segmentation. The three genetic operators are selection operator, crossover operator, mutation operator. Selection is a method that randomly picks chromosomes out of the population according to their evaluation function, the higher the fitness function, more the chances of an individual to be selected. Crossover is the process of taking two individuals or parent solutions and producing from them two offspring's. The reproduction or crossover operator selects a pair of two individuals for mating. Mutation, by changing the genes, can produce a new chromosome.

2. METHODS

The overlapping and touching of the chromosomes usually occurs during the cell division and hence results in certain abnormalities like Down syndrome, Edwards syndrome, Turner syndrome etc. Hence the segmentation helps in minimizing these chromosomal abnormalities. Hence this segmentation is carried out on the basis of genetic algorithm, which is an evolutionary algorithm and is an optimization technique which helps in optimizing the energy function to get better segmentation results. Here the contrast regions in the image are chosen as the fitness function based on the intensity values and then the segmentation is carried out. Hence the overlapping regions in an chromosome images is been identified based on the masking concept. The proposed work is composed of the below blocks, the overlapping/touching chromosome images are taken as the input image. The preprocessing steps are necessary because the chromosome images are irregular in shape and hence the borders of the chromosome images must be made visible to carry out the further steps. Once the boundary of the chromosome image is been detected then it can processed further.

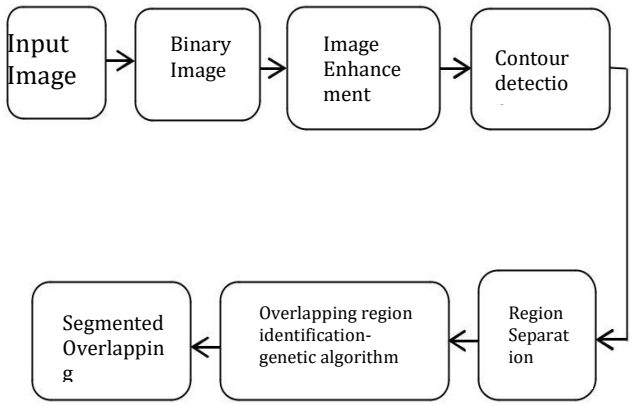

Fig.1 Block Diagram Of the Proposed Method

2. 1 Binary Mapping

The grayscale chromosome images are converted to binary image. The binary image is nothing but representing the image in terms of 0s and 1s.The entire pixel values of the grayscale/ colour images are reduced to the binary values. The binary mapping in image processing helps in reducing any discontinuities in an image. Binary images are produced from color images by segmentation. Segmentation is the process of assigning each pixel in the source image to two or more classes. If there are more than two classes then the usual result several binary

images. A binary image is a digit image that has only two possible values for each pixel. The color used for the object in the image is the foreground color while the rest of the image is the background color.

2.2 Image Enhancement

The overlapping chromosome gray scale image is been taken as the input. Hence the image edges are not clear the preprocessing steps are been carried out i.e. image enhancement which is done using histogram processing. Thus image enhancement helps in increasing the contrast of an image. The various overlapping images are taken as input to give the output. Though the chromosome images are irregular in shape and are not clearly

2.3 Contour Detection

Contour detection is the set of mathematical methods which helps in identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges.

2.3 Genetic Algorithm

GAs were proven to be the most powerful optimization technique in a large solution space. The overlapping or touching region in the chromosomes is to be segmented based on the genetic algorithm. The genetic algorithm is an evolutionary algorithm and it is an optimization technique which optimizes the energy function to provide better segmentation results. Here the overlapped regions are enlightened using the genetic algorithm. The fitness function that is to be selected is the image contrast regions in an image which is subdivided into Low contrast**,** Medium contrast, and High contrast regions based on which the regions are grouped. The intensity values in an image ranges from 0-255, based on these intensity values certain threshold value is been set in order to classify the image contrast regions into three, which is the fitness function that is to be selected for the genetic algorithm. The threshold values are been selected that divides the intensity values of an image into three regions which is Black(low contrast), White(high contrast), CVF(medium contrast).Based on these divided regions the enlightening of the overlapped regions in an chromosome image. These image contrast regions in an image are been assigned various colors to differentiate these contrast regions based on its pixel values. The colors yellow blue and purple colors are been assigned to these regions.

3. DATA SETS

This paper work is examined with a total of 500 evolution iterations per image, which takes about 8.5 min per image implemented in MATLAB (2010a, The MathWorks, Natick,MA).The overlapping chromosome images are taken and the algorithm is applied 25 times over an image to identify the overlapping region.Since the chromosome images are irregular in shape certain preprocessing steps was carried out.

4. RESULTS AND DISCUSSION

In the proposed work the overlapping chromosome images are taken These are grayscale non rigid images whose shapes vary from one image to other. The shapes are irregular and discontinuities are present in the image. The overlapping and touching of the chromosome images usually occurs during the cell division. Thus these overlapping denote the chromosomal abnormalities and which is to be diagonosed or which results in certain genetic disorders. The figure 2 represents the input chromosome images.

Fig.2 Input Chromosome Images

The Figure.3 represents the binary image where the grayscale image is been converted into binary image.

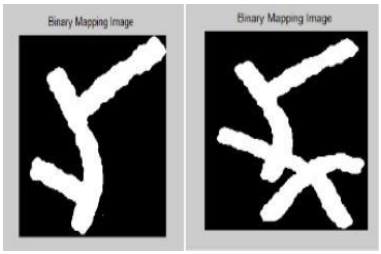

Fig.3 Binary Image

The overlapping chromosome gray scale image is been taken as the input. Hence the image edges are not clear the preprocessing steps are been carried out i.e. image enhancement which is done using histogram processing. Thus image enhancement helps in increasing the contrast of an image. The various overlapping images are taken as input to give the output. Though the chromosome images are irregular in shape and are not clearly visible, the preprocessing steps are required in order to carry out further processing steps, so image enhancement is done as the preprocessing step. Image enhancement techniques have been widely used in many applications of image processing. Contrast is an important factor in any subjective evaluation of image quality. The fig.4 represents the enhanced image.

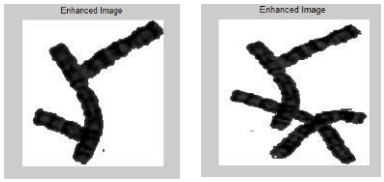

Fig.4 Image Enhancement

Edges are significant local changes of intensity in an image. This provides a line drawing of an image. The figure 5 represents the contour image.

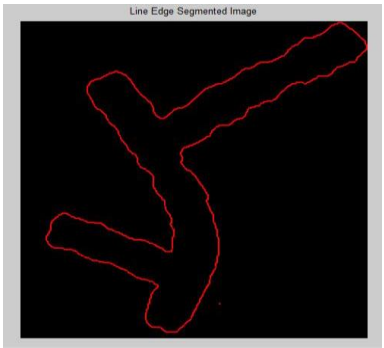

Fig.5 Contour detection

The figure 6 and 7 represents the region separation in an image based on the image contrast. The colours are given in order to differentiate between the various contrast region in an image.

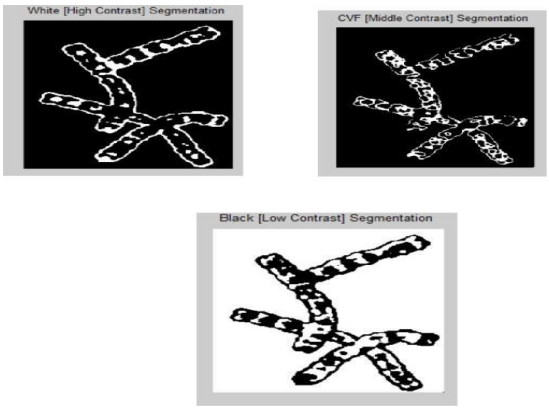

Fig.6 Region Separation

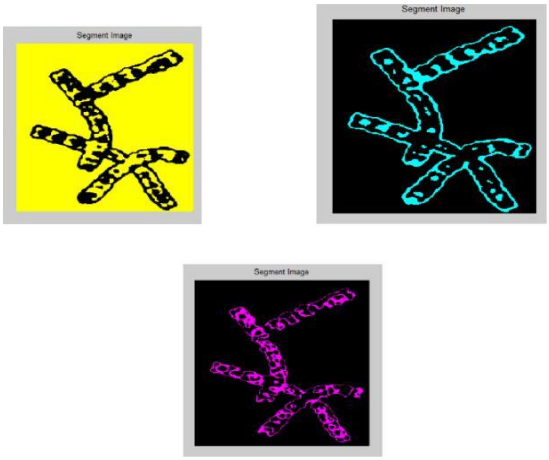

Fig.7 Colour Assignment

The regions where the overlapping is more is shown using majority colour based on its intensity values. Based on the genetic algorithms worst case, best case and average case concept the best case is identified as the overlapping region in the chromosome image. The overlapping region in an chromosome image is shown in figure 8.

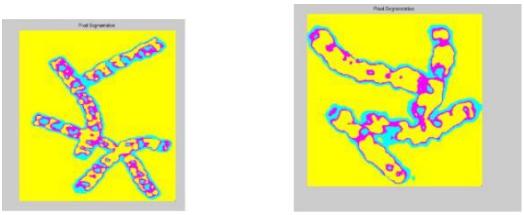

Fig.8 Overlapping Regions

The mask created for an image is shown in figure 9

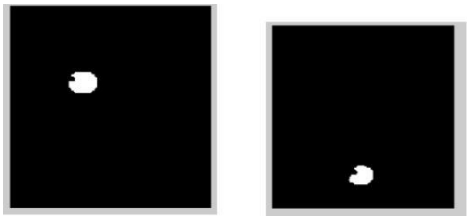

Fig.9 Masks created

The masks are created for the chromosome images after performing number of iterations and finally the structure of the chromosome images are identified. The figure 10 represents the chromosome mask.

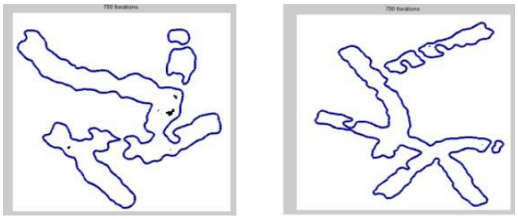

Fig.10 Structure analysis

Using the mask concept the overlapping regions in an chromosome images are segmented. By fitting the masks over the chromosome images the overlapping regions are clearly identified. The created masks are then fitted over the overlapped regions to segment the overlapped regions. The figure 11 represents the overlapping zones in an image

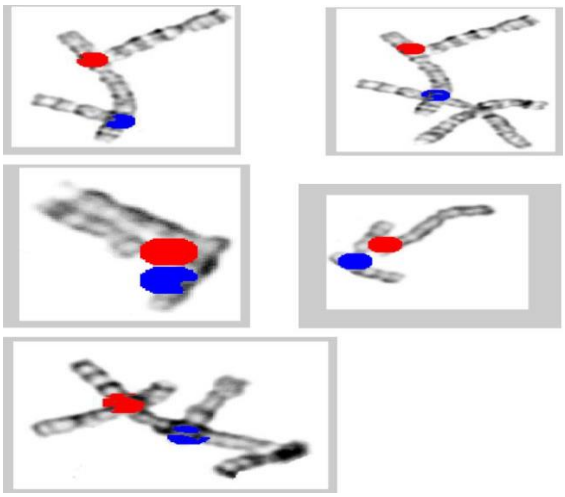

Fig.11 Overlapping regions

5. CONCLUSION

The proposed work is performed over the overlapping and touching non rigid chromosome images. The overlapping chromosome images denote the chromosomal abnormalities and which is to be diagonosed immediately to reduce the birth defects. The overlapping and touching of the chromosomes usually occurs during the cell division and hence results in certain abnormalities like Down syndrome, Edwards syndrome, Turner syndrome etc. Hence the segmentation helps in minimizing these chromosomal abnormalities. Hence this segmentation is carried out on the basis of genetic algorithm, which is an evolutionary algorithm and is an optimization technique which helps in optimizing the energy function to get better segmentation results. Here the contrast regions in the image are chosen as the fitness function based on the intensity values and then the segmentation is carried out. Hence the overlapping regions in an chromosome images is been identified based on the masking concept. The chromosomal overlapping and the touching position indicate that the chromosomes are in a diseased state. So the segmentation of the chromosomal structures helps in reducing those abnormalities. The chromosomal abnormalities normally occur during the cell division so its segmentation plays a vital role in diagnosis purpose.

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