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Medical Image Processing of Para Nasal Sinus and Nasal Cavity from Cone-Beam CT Images by Using Micro-Array Algorithm (MAA)

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Abstract

Background and objectives: This paper produces a new method of paranasal sinuses and nasal cavity image processing by MicroArray algorithm. Malignancy can occur in any of the cells, that line mucosa. Every variety of malignancy differs based upon its growth and behaviour. We examined the accumulation paranasal sinuses and nasal cavity image a better segmentation will make easier to read and identify the cavity by the expert physician **Methods:** Nasal Cavity and Para nasal image results are difficult to considerable from the different types of image modalities by expert surgeon. In order to get both qualitative and quantitative results, we has been developed a system for diagnosis of para nasal sinus and nasal cavity using MAA algorithm. **Results**: The modalities images of para nasal sinus and nasal cavity are segmented using looping method of MicroArray (MAA) algorithm to extract the each pixel in means of extracellullar components of an image. The segmentation is the one of the main process of the system uses microarray conversion to a single pixel of image using Principal Component Analysis (PCA) that has highest bright then normalize the actual image to the array range. **Conclusion:** Segmentation of paranasal sinuses and nasal cavity has more advantages, that with less mental risk easily diagnosis the problem by respective physician reduces the time spending with specialists and decreases the intra and inter observer differences.

Keywords: Image Analysis, Micro Array, MAA Algorithms, thresholding, Paranasal Sinuses

Introduction

In a modern medical world, medical imaging is playing a major role in diagnosis of human body's internal diseases. Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology). Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease, past two decades the technical research area of imaging dramatically grown up in this field of research the involvement expertise from different disciplines not only in computer science but also in mathematics and physics. There are different types of modeling techniques applied to improve medical images upon the physician request, those different modalities are, ultra sound, x-ray, cone-beam Computed Tomography (CT- scan) magnetic resonance imaging (MRI). Here we are handling the medical image of paranasal sinuses and nasal cavity.

The space inside the nose is referred to as Nasal cavity, which warms, moistens and filters air, when one inhales. The bones around this cavity have small hollow spaces (small tunnels) in them called as paranasal sinuses. These sinuses generally affect one's sound system impacting tone and voice. Where the air passes during breathing process, the nasal cavity opens into two nasal passages through it [1]. Surrounding the nasal passages, there is a chained pair of sinuses like maxillary sinuses present in the cheek area, inferior to eyes on either side of the nose, frontal sinuses present in the upper side of inner eye and eyebrow area, Sphenoid Sinuses present in the deep behind the nose, and in between the eyes, and the ethmoid sinuses are present superior to nose, between the eyes. Usually these sinuses are occupied with air. In case of cold or sinus infection, these can be obstructed due to mucus and pus formation. The paranasal sinuses consists of a layer of mucus producing tissue known as "**mucosa**", which is comprised in any one of the types, the cell types are; Squamous epithelial cells are flat in appearance, forming major part of the mucosa, Glandular cells are responsible for the production of mucus and other fluids, Nerve cells are helping in sensation and sense of smell in the nose, and infection fighting cells are vascular cells and other supporting cells.

Malignancy can occur in any of the cells, that line mucosa. Every variety of malignancy differs based upon its growth and behaviour These cancer types can be studied under the following sub-headings: **Squamous Cell Carcinoma:** This is among the common type of cancer affecting squamous epithelial cells lining the paranasal sinuses and nasal cavity. .**Adenocarcinomas**, **Adenoid cystic carcinoma** and **Mucoepidermoid cancers**: These are the next most usual type of carcinomas in nasal and paranasal sinuses affecting the minor salivary gland cells. **Undifferentiated Carcinoma:**This cancer is one of the fastest growing types, in which it is very difficult to state the type of cell cancer started in, due to abnormal appearance of the cells. **Melanoma**: Melanocytes responsible for Melanoma grow and spread quickly on sun exposed areas of the skin. Also, these can cause cancer on the lining of the paranasal sinuses and nasal cavity or additional parts inside the body. **Esthesioneuroblastoma:** This type of cancer impacts the olfactory nerve and the tumour developed is called as **neuroblastoma**. This typically arises on the top of the nasal cavity affecting cribriform plate. Certain times, these growths are mistaken for undifferentiated carcinoma or lymphoma. **Lymphomas:** Lymphocytes lining the paranasal sinuses and nasal cavity can be affected by T-cell/natural killer cell nasal type lymphomawhich was earlier referred as **lethal midline-granuloma. Sarcomas:**These are the malignancies of

musculoskeletal and fibrous cells that can get initiated in any of the body parts, comprising the nasal cavity and paranasal sinuses.

Certain times, there are other types of growths which are found in the nasal cavity and paranasal sinuses(figure 1).. These are non-cancerous in nature however they can lead to obstruction and may cause problems, such as Nasal polyps, Papilloma's, and Inverting Papilloma[2].

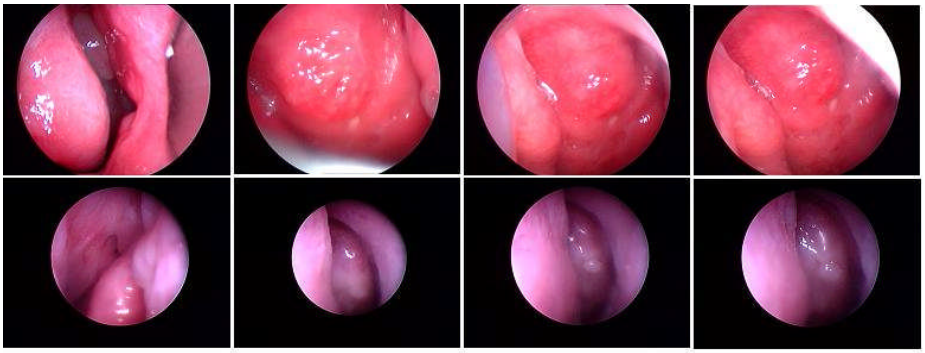

Figure 1 : Endoscopic View of Nasal Cavity with Nasal Tumar

Segmentation plays a main role in paranasal sinuses and nasal cavity imaging system. Segmentation is a technique that divide an image into its constituent part or small objects of an image, each image contains set of pixels, each pixel of an objects very similar according to some homogeneity criteria that is color, intensity or texture so as to locate and identity boundaries of an objects, segmentation is the only solution of all kind of image analyzing problems. Our aim is to localize the scanned organs of human body; segmentation is a main role as implies a great clinical value in paranasal sinuses and nasal cavity imaging.

Characteristics of these malignancies

It has been found that paranasal sinuses and nasal cavity cancer do not exhibit any symptoms at early stages. These cancers are generally identified and diagnosed in the later stages when the patient is undergoing tests or medical checkups for any other inflammatory diseases such as Sinusitis or benign tumours. However, having any of the below cited symptoms does not indicate that the person is affected with Nasal cavity or Paranasal sinuses cancer. In fact, before reaching to any conclusion, a doctor has to rule out the condition to be treated.

Characteristics of these cancers include: Nasal clogging and Stuffiness which worsens with time, Pain below and above the eyes, Nasal obstruction on one side of the nose, Epistaxis (Nasal bleeding),Nasal pus discharge, Reduced sense of smell, Numbness around the face, Loosening of teeth and sensory loss, Growth in nose or palate, Continuous moist eyes, Protrusion of one eye, Vision changes which may lead to vision loss, Difficulty in oral

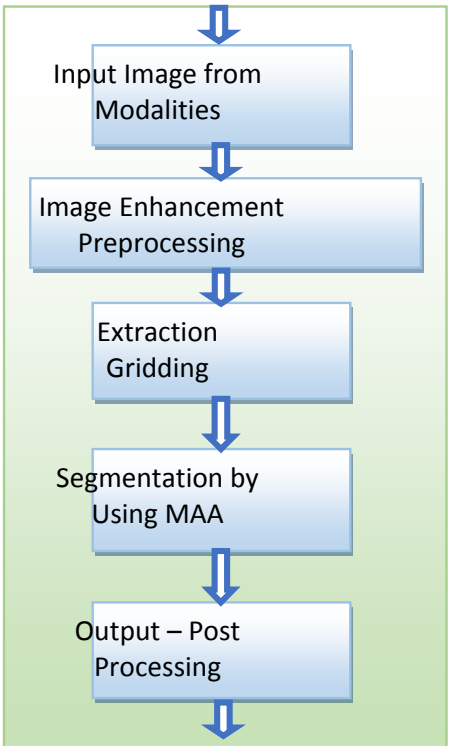

Fig:1 Expectation Micro-Array Segmentation

movement, An ulcer or lump inside the nose that does not heal, Enlargement of lymph nodes found in the neck

Proposed system

Figure 1 describes the flow of medical image from the different modalities like MRI, CT-Scan, X-ray and etc., we receive as a input image and transferred to image enhancement preprocessing for to filter the noise, image edges of extracted images intensity normalization. The extraction gridding part will do extracts the feature like intensities, color and texture from the enhanced preprocessed image. The extracted features of image we do the segmentation process by using MicroArray Algorithm (MAA Algorithm). Finally classification, visualization and interpretation are done by the post processing techniques.

Applications of medical image segmentation is very Importance and more advantages in medical aided technology, like to locate the tumors for to understand the physician, measure the tissue volumes, surgery to take place by computer aided design, proper diagnosis, treatment planning and proper study of human anatomy[3].
Segmentation of paranasal sinuses and nasal cavity has more advantages, that with less mental risk easily diagnosis the problem by respective physician reduces the time spending with specialists and decreases the intra and inter observer differences[4].

Methods and materials:

Image analysis:

The MicroArray image analysis in the following two stages

1. Image Blend: in the MicroArray image creation process, two images are obtained from the modalities i.e. red channel [Ry2] and green channel [Gy4] images stored in 32- bit, for to analysis of this 32-bit image converted into 16-bit of each and this divided into 8 bit of each by using the formula of function f is defined as,

$$= \sqrt{(R1 + R2)^2 + (G1 + G2)^2}$$

2. Image Enhancement: incase the MicroArray image's contrast is low, the extracted image quality is very poor. The edge of image information is the basic source of automotive clustering of microarray image [5]. When MAA Algorithm extends the original to the quality of spot edges prior to the computation of image gridding.

Clustering – Subtractive algorithm

Clustering Subtractive algorithm is one of the most widely used clustering method, mainly concentrating on the density of the edges pixels [6]. The disadvantages of this extension of the clustering mountain algorithm increase the dimension of edge data and calculated complexity grows in exponentially. The subtractive algorithm has been over taken the pixels from the centre as the cluster and solved this problem. We can assume Px(a) is the total value of an image pixel, each pixel is defined as a potential cluster. Where Px(a, b) is $\{a_1,a_2,a_3,....,a_n\}$. So the centre potential pixel a_n can be written as;

$$\sum_{i=1}^{n} e^{\frac{-4|a_n - a_j|^2}{r2n}}$$

Where r_a is a cluster radius in pixel of image value space and it must be a positive constant and || is the distance between the pixel.

MAA based contrast Enhancement:

The following algorithms make our image contrast enhancement;

Divide the microarray image into Blend Mode Function (BMF) by using two-dimensional empirical decomposition [7-9].

$$TDMD\ (F) = [bmf_1, bmf_2, \ldots, bmf_n]$$

After the first step, all enhanced images are added i.e, summation of BMFs, with each BMF multiplied by its weight w_i , and it's been optimized by MAA Algorithms.

$$EMI = \sum_{i=1}^{n} (w_i * bmf_i)$$

w_i is the weight of the i^{th} position of an array BMF's image weight.

Randomly chromosome or plasma of image generated with initial weights of BMFs population. The length is equal to the number of BMFs was generated by the TDMD array and each element correspondence with BMF weight. The values are 0 and 1differs in weight, but the summation equals to 1.

By using the entropy function, calculate the finest value of each plasma or chromosome its defined as;

$$Entropy = -sum(p.*log2(p))$$

From the results of entropy values the chromosomes are selected using wheel technique.

Use two main operator such as crossover and mutation are used to produce new chromosomes from the current population with the probabilities of 0.5 and 0.05.

To stopping criteria we may use maximum number of iteration in results the values of chromosome are used as optimum weights in constructing the enhanced image.

Gridding or Localization of Image:

The micro array image dividing into blocks or sub-gridding and each blocks again divided into sub-blocks or spot-detection. The final sub-block contains a single spot having only two regions spot and background. The existing algorithm [10,11] is semi-automatic gridding, also need the size of the spot, number of rows and columns of the spot. In this algorithm designed fully automated gridding in shown in fig 2.

Results:

Segmentation:

Segmentation is the process, which makes a grouping the pixels of image from various sub-blocks into non-overlapping region[12], spot region and background region. The MAA Algorithm for segmentation;

Where P is the population of chromosomes, and each contains K clusters are selected randomly. The finest chromosome considered by its value and evaluated using KMI and Jm measure defined as follows;

$$U_{ik} = \frac{1}{\sum_{j=1}^{K} \left(\frac{D(zj,xk)}{D(zj,xk)}\right)^{\frac{2}{m-1}}}$$

Where D is the Euclidean distance, x_k image pixels, m fuzzy exponent, U membership values and z_i centre of cluster

The k-means index defined as follows:

$$KMI = \frac{1}{\sum_{k-1}^{K} \sum_{i=1}^{N} |x_i - z_k|2}$$

The chromosomes are selected using roulette wheel selection technique. Always we select the chromosomes with maximum fitness value. With 0.7 crossover rate and 0.05 mutation rate. The new population generated and replaced with old one. Iteration will stopping by the maximum criteria. As a results Solution classified image from the execution stops[13,14].

Extraction information:

Spot information includes the calculation of expression ratio in each region of every spot in the micro array image. i.e.,

$$Expression\ Ratio = log_2 \frac{R}{G}$$

The expression ratio measures the transcription abundance between two sample spot[15-17]. The MAA Algorithm based on segmentation of the single spot is shown in fig 3.

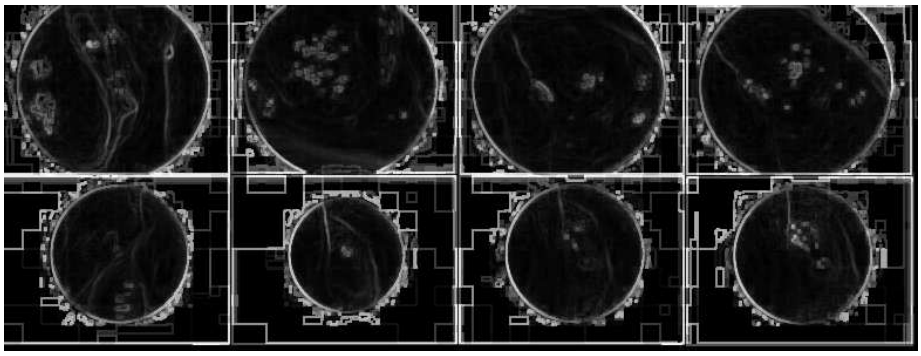

Figure 2 : Segmented Endoscopic View of Nasal Cavity with Nasal Tumar

Discussion

Due to different reasons of cause various types of cancer especially in paranasal sinuses. Researchers continue to look into the reasons of factors cause these types of cancer. Although there is no solution to completely prevent nasal cavity and paranasal sinus cancer. The extracted features of image we do the segmentation process by using MicroArray Algorithm (MAA Algorithm). Finally classification, visualization and interpretation are done by the post processing techniques. Based on the simulations performed, we conclude that, MAA algorithm segmented the micro array cellular components of the image very well and the Adaptive Thresholding increases the accuracy, gives better segmentation for visibility. It has been compared with the previous research and seems to be very perfect and accurate. Here we are comparing the two kinds of study approaches done by the different authors, connected component labeling works on binary or gray level images and different measures of connectivity are done in, Digital Image Processing binary input images and connectivity. Another possible approach is called marker based water shed segmentation in digital image processing using MATLAB[18]. MATLAB not fully supports a number of powerful indexing schemes that simplify array manipulation and improve the efficiency of algorithms[19]. With this method, you have to find a way to “mark” atleast a partial group of connected pixels inside each object to be segmented. You also have to mark the background[20].

These both approaches not fully satisfied by ENT surgeon, also they are familiar with these cell images, so they want to know exactly what they were looked at the microscope. Since their expectation do more and more some of these blobs need more help to be separated properly. So we have got more attention in that. With this method, you have to find a way to "mark" at least a partial group of connected pixels inside each object to be segmented. You also have to mark the background. The result of sampling and quantization is a matrix of real numbers.

But the MAA Algorithm components labeling operator scans the image by moving along a row until it closer sight in form of pixels. So it's very easy to identify by the ENT surgeon and the results are robust, accurate and quantitative. Simulations were performed on more than three microscopic images of paranasal sinuses and nasal cavity.

Recommendations and Conclusion:

Expectation of Micro array technology is used for parallel analysis of spot expression ratio of different blocks of an array in a single experiment. The analysis of microarray image is done with gridding. The expression ratio measures the transcription abundance between two sample spot. Segmentation of paranasal sinuses and nasal cavity has more advantages, that with less mental risk easily diagnosis the problem by respective physician reduces the time spending with specialists and decreases the intra and inter observer differences. Optimizing multiple cluster validity indices will produce better results than optimizing single validity index.

Conflicts of Interest

There is no conflicts of Interest

Author Contribution:

Talal Aljeraisi , Conceived and designed the study, is responsible for the surgical part, provided research materials and helped to write the scientific publication and Participated in collecting the scientific material and helped to write the scientific publication and discussion. All of the authors have critically reviewed and approved the final draft and are responsible

for the content and similarity index of the manuscript. **Abdulrahman H Ali** Image segmentation has been analyzed and interpreted data, provided the samples for the research, and helped to write the scientific publication. Coordinated the plan of the project and participated in collecting the scientific material.

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