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PAP-SMEAR IMAGE SEGMENTATION INTO NUCLEUS AND CYTOPLASM USING MULTILEVEL IMAGE THRESHOLDING

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Abstract:
Segmentation is the the major image processing task used to identify area of interest from given image. Nucleus and cytoplasm is the two important cell characteristics for detection of cervical cancer through pap smear image. Various methods of segmentation can be used like thresholding, clustering, edge detection, region extraction in medical image processing. For this rerearch we have proposed multi level image thresholding thechniques for segmention of nucleus and cytoplasm at different threshold level. Each single cell pap smear image is segmented in three regions namely nucleus, cytoplasm and background of image.

Key Words: Image Segmentation, Multilevel Thresholding, Cervix Cancer, Pap Smear, Nucleus Detection & Cytoplasm Detection

1. Introduction:

Cervix cancer is one of most found cancer in adult women in whole world. It is prevental if dignosied at pre cancereous stage under proper medical care. It is one of the most common causes of deth for women in America [1]. The cervical cancer death rate has been reduced by approx 50% due to incerease the pap smear test. Figure 1 shows estimate 5-year prevalant cancer cases[2] in India like developing country.

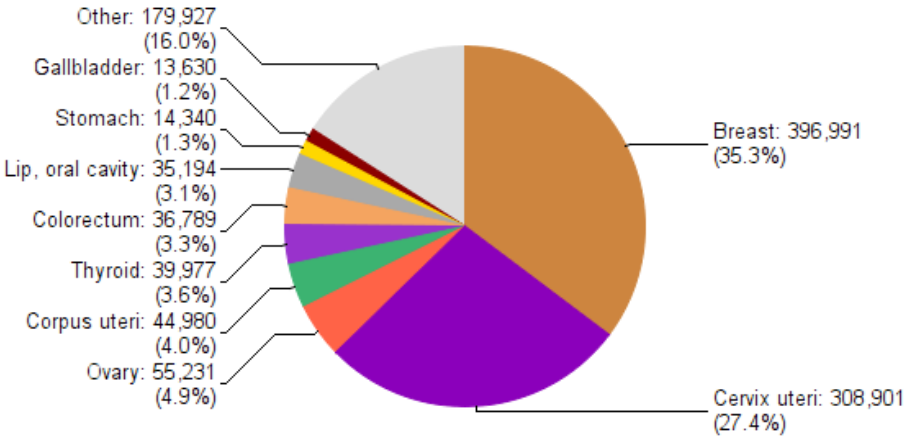

Figure 1: Estimated 5-year prevalent cancer cases in India [2]

A specimen is taken from the uterine cervix and transferred onto a thin, rectangular glass plate by using cotton stick or small brush and colored by means of the Papanicolau method [4, 5]. Coloring helps to examine under a microscope by assigning different color to nucleus and cytoplasm to detect any abnormality indicating at precancerous stage. Figure 2 shows the single cell pap smear image used for this research [3].

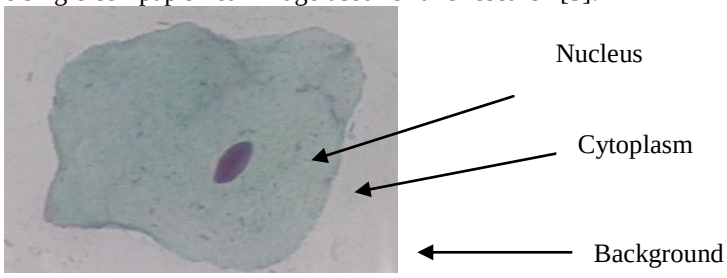

Figure 2: Cell Characteristics

Computer aided diagnosis uses digital image processing techniques on pap-smear images to detect stages of cancer and classify into normal or abnormal categories. A lot of research has been done but yet there is large scope to improve the result. An efficient pap-smear test classifier used [6] with two highly efficient second order neural network training algorithms, namely the LMAM (Levenberg Marquardt with Adaptive Momentum) and OLMAM (Optimized Levenberg-Marquardt with Adaptive Momentum). New pap-smear image data base used [7] that consists of 917 images of pap-smear cells includes 242 normal images and 675 abnormal images, further 20 features are used for the classification process such as nucleus and cytoplasm area, N/C Ratio,

nucleus and cytoplasm brightness, nucleus shortest and longest diameter, cytoplasm shortest and longest diameter etc. many of image segmentation techniques are reviewed [8] into mainly three category characteristics feature thresholding, edge detection and region based image segmentation. These segmentation techniques widely used in biomedical areas in detection of cancerous cells. A non-parametric hierarchical segmentation algorithm proposed [9] for segmentation of pap semar images to deal with various challenges such as improper staining, poor contrast and overlapping cells. The rest of the paper is organized as section 2 deals with proposed methodology used for this work, section 3 describes results of proposed approach and finally paper has been concluded in section 4.

2. Proposed Methodology:

Segmentation of nucleus and cytoplasm involves various steps like removal of noise, conversion to binary image using muti level thresholding. Figure 3 shows the approach used in the proposed work.

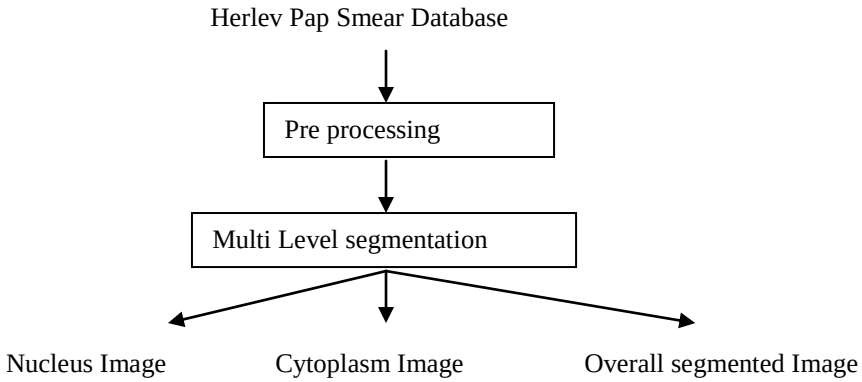

Figure 3: Proposed methology used for this paper

2.1 Herlev Pap Smear Database: For this research Harlev pap smear database is used [3]. Pap smear data analysis has been done [7] on this database of 500 images including 200 normal and 300 abnormale pap smear cell image. For this research we have used only 100 images including 50 normal and 50 abnormal pap semar images. Normal pap smear images can be of either of squomous, columnar or intermediate region and abnormal images can be mild, moderate or severe dysplastic cells.

2.2 Pre-Processing: Preprocessing of pap semar images involves mainly three steps conversion into gray scale image, filtering by average gaussian filter of 3 x 3 for smmothing. Figure 4 shows preprosessed image and binary image obtaind by single level thresholding.

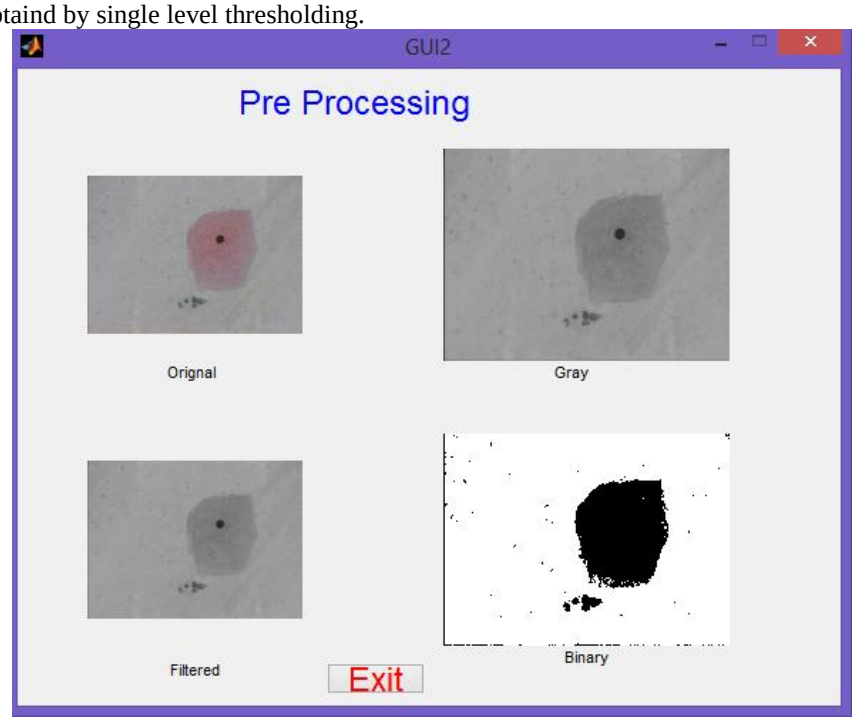

Figure 4: Preprocessed image

Above binary image formed by single level thresholding is not able to distinguish between nucleus and cytoplasm of image, so a new segmentation approach required.

2.3 Multi Level Segmentation: For this research segmentation has been done on two or more level as following algorithm. Let I(x,y) is an image intensity of gray scale image at (x,y) and T1 is the threshold limit for 1st level, so modified image I1 can be obtained by

$$\text{Modified image } I1(x,y) = \begin{cases} 1 & if\ I(x,y) > T1 \\ 0 & other\ Wise \end{cases} \quad (1)$$

Furthermore, let T2 is new threshold limit for modified image I1, then new image I2 can be obtained by

$$\text{New image } I2(x,y) = \begin{cases} 1 & if\ I1(x,y) > T2 \\ 0 & other\ Wise \end{cases} \quad (2)$$

3. Result and Discussion:

Result of propose approach of segmentation are shown in figure 5 and 6 for normal and dysplastic cell of pap smear image respectively.

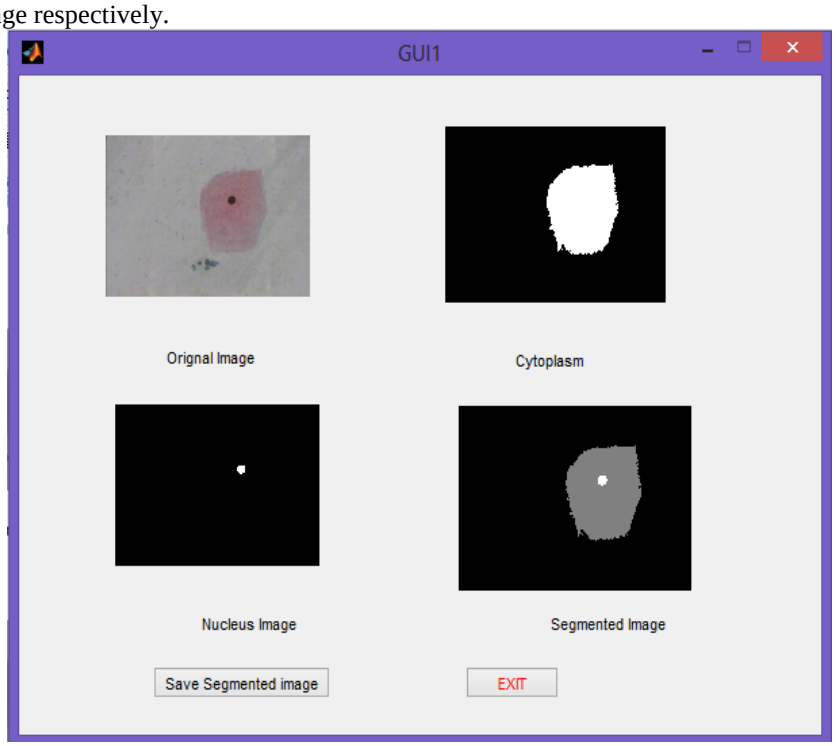

Figure 5: Segmented image of normal image

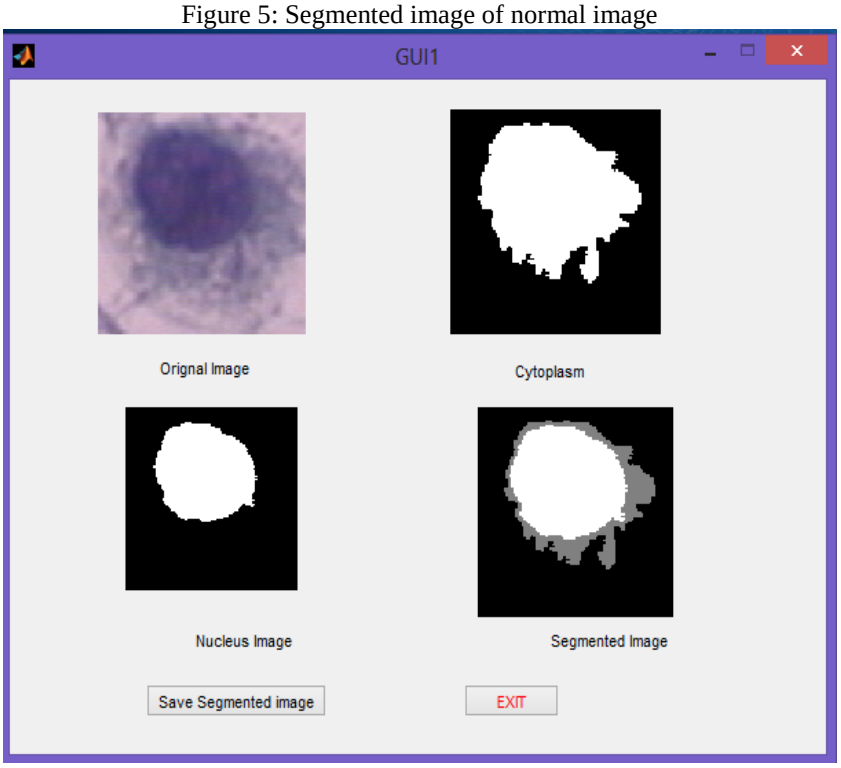

Figure 6: Segmented image of dysplastic image

4. Conclusion and Future Work:

Cervical cancer is one of dangerous cancer found in women that needs to be diagnosed at precancerous stage. In current days cyto-technician is counting number of malignant cells manually on basis of image created during pap-test. The proposed approach clearly separate nucleus and cytoplasm from original pap smear image and limited to only for segmentation. Other segmentation techniques like watershed, active contour method may give better result. This segmented result will help to calculate various shape features like nucleus area, cytoplasm area and other various features that will help for pap smear classification for future work.

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