International Journal on Recent Researches In Science, Engineering & Technology
(Division of Computer Science and Engineering)
A Journal Established in early 2000 as National journal and upgraded to International journal in 2013 and is in existence for the last 10 years. It is run by Retired Professors from NIT, Trichy.
It is an absolutely free (No processing charges, No publishing charges etc) Journal Indexed in JIR, DIIF and SJIF.
Research Paper
Available online at: www.jrrset.com

ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105

Volume 4, Issue 11, November 2016

JIR IF : 2.54
DIIF IF :1.46
SJIF IF: 1.329

An Effective Method for Prediction of Cervical Cancer using Pap Smear Screening Test

[1]M.MUTHUSELVI, [2]S.ATHINARAYANAN
[1]E-Mail : muthuselvibe@gmail.com,
II[nd] Year M.Tech.IT Student, Department of IT, PSN College of Engineering and Technology. Tirunelveli Dist, Tamilnadu State, INDIA.
[2]E-Mail : aathithee@gmail.com,
Assistant Professor, Department of IT, PSN College of Engineering and Technology. TirunelveliDist, Tamilnadu State, INDIA.

Abstract :

Now a day most of the women are affected by spreading cervical cancer. So, most of the researchers and pathologists are tried a lots to identify this cancer. But their results are not accurate and it was coming with human errors. In order to minimize the human error of the pathologists, an automated detection system of cervical cancer cells has been developed. The detection of cervical cancer cells is based on the morphology of the cells. Test result shows, that by using mean value of the cell features is able to identify and also differentiate between normal and cancerous cervical cells. In this system will hopefully help the pathologists to reduce their work-load and improving the accuracy of the system.

Key-Words:

Cancer, Cervical Cancer, Nucleus Segmentation, Nucleus Feature Extraction, Classification.

1.Introduction

Cancer is a class of diseases in which a group of cells display the traits of uncontrolled growth (growth and division beyond the normal limits), and sometimes metastasis (spread to other locations in the body via blood). Cervical Cancer is a malignant cancer that is affected by the women cervix cell (Thinprep) in the cervical area. Cervical screening is not a test for cancer. It is a method of preventing cancer by detecting and treating early abnormalities which, if left untreated, could lead to cancer in a woman's cervix (the neck of the womb). The sample of cells is 'smeared' on to a slide which is sent to a laboratory for examination under a microscope.All women between the ages of 25 to 64 are eligible for a free cervical screening test every three to five years. Uterine Cervical Cancer is one of the most common forms of cancer in women worldwide. Most cases of cervical cancer can be prevented through screening programs aimed at detecting precancerous lesions. During Digital Colposcopy, colposcopic images or cervigrams are acquired in raw form. They contain specular reflections which appear as bright spots heavily saturated with white light and occur due to the presence of moisture on the uneven cervix surface and. The cervix region occupies about half of the raw cervigram image. Other parts of the image contain irrelevant information, such as equipment, frames, text and non-cervix tissues. This irrelevant information can confuse automatic identification of the tissues within the cervix. Therefore we focus on the

cervical borders, so that we have a geometric boundary on the relevant image area [1]. Our novel technique eliminates the SR, identifies the region of interest and makes the cervigram ready for segmentation algorithms.

During Digital Colposcopy, Specular Reflections (SR) appear as bright spots heavily saturated with white light. These occur due to the presence of moisture on the uneven cervix surface, which act like mirrors reflecting light from the illumination source. Apart from camouflaging the actual features, the SR also affects subsequent segmentation routines and hence must be removed [2].

Specular reflections strongly affect the appearance of images, and usually hinder the computer vision algorithms applied to them. This is particularly the case with uterine cervix images. The highlights created by specular reflections are a major obstacle in the way of automatic segmentation of such images [3]. An independent system to use automatically extracted and matched features from a colposcopic image sequence in order to generate position landmarks.[8]. These landmarks may be used either to measure the accuracy of a registration method to align any pair of images from the colposcopic sequence or as a cue for registration[9]. Most cases of cervical cancer can be prevented through screening programs aimed at detecting precancerous lesions. Colposcopy cervical images are acquired in raw form which contains major cervix lesions, regions outside the cervix and parts of the imaging devices such as speculum. In this study, a fully automated lesion detection method based on active contour is proposed. To detect the lesion, the active contour method requires an initial mask in the acetowhite region [5].

The watershed segmentation map of the input image is modeled using an MRF in which watershed regions correspond to binary random variables indicating whether the region is part of the lesion tissue or not. The local pairwise factors on the arcs of the watershed map indicate whether the arc is part of the object boundary [6&10].

A novel feature screening algorithm by deriving relevance measures from the decision boundary of Support Vector Machines. It alleviates the "independence" assumption of traditional screening methods, e.g. those based on Information Gain and Augmented Variance Ratio, without sacrificing computational efficiency [7].

2.Proposed Methodology

The Proposed Methodology Consists of three main process for classifying the given cervical cell as normal or abnormal cell. That is thresholding, Nucleus Segmentation, Feature Extraction and Classification Process. This process was shown in given Figure.1.

List of Modules:

It Consists of Six types of the Modules.

That is,

1. Image Acquisition.
2. Image Conversion.
3. Thresholding.
4. Morphological Segmentation.
5. Feature Extraction.
6. Classification.

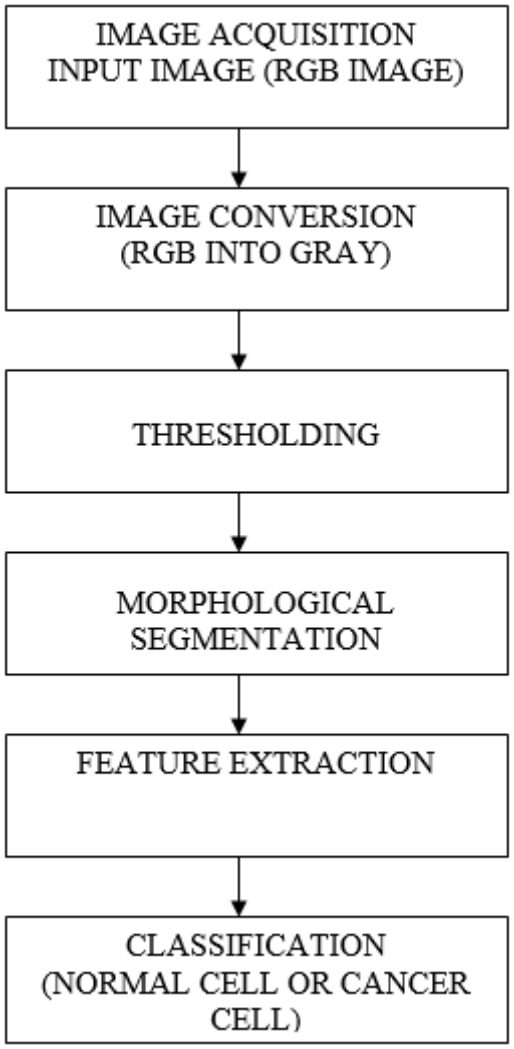

Figure.1. Proposed Methodology

Modules Description:

2.1. Image Acquisition:

Process:

To acquire the input Cervical Cell Image (Color Image – RGB Image (Fig.2)) for further Processing.

Result:

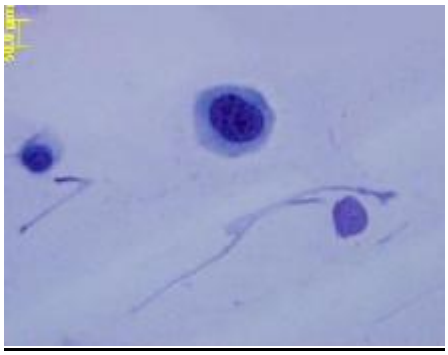

Fig.2.Input Image

2.2 Image Conversion:

Process:

The given Input image (Color Image – RGB Image) is converted into Grayscale Image – Figure.3).

Result:

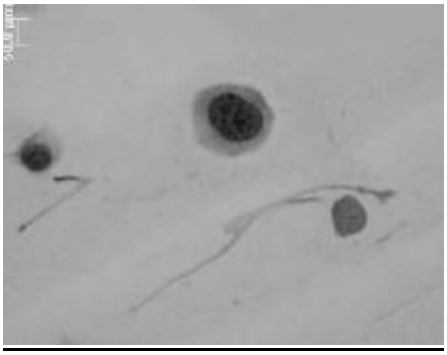

Fig.3.GrayScale Image

2.3 Thresholding:

Process:

In this process used for finding where the nucleus has presence in an image – Figure.4.

Result:

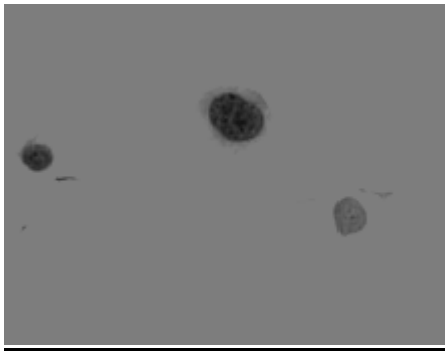

Fig.4. Thresholding Image

2.4 Morphological Segmentation:

Process:

The given gray scale image contains one or more cervical cell image. But thatCellcontains not only the Nucleus but also its Surrounding Cytoplasm. Hence in order to remove the surrounding cytoplasm of the cervical cell the following two types of the morphological operations closing (Fig.5) and opening (Fig.6) are used.

Result:

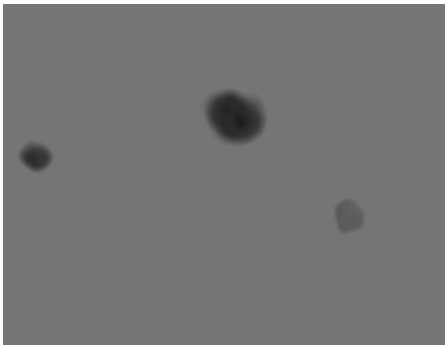

Fig.5. Morphological Closing Image

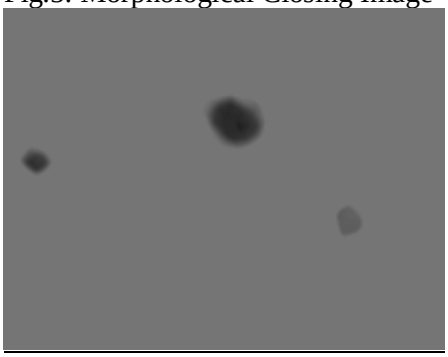

Fig: 6.Morphological Opening Image

2.5 Feature Extraction:

Process :

After the Segmentation Process was over, then we able to select the edge of the nucleus exactly of the each and every one of the cervical cell that was present in that image (Fig.7). For these process we go for Binarized process. Then, after this process, count the no of pixels occupied as nucleus and we extract the feature (Area) of the nucleus (Fig.8-10).

Result:

Fig.7 Binarized Image

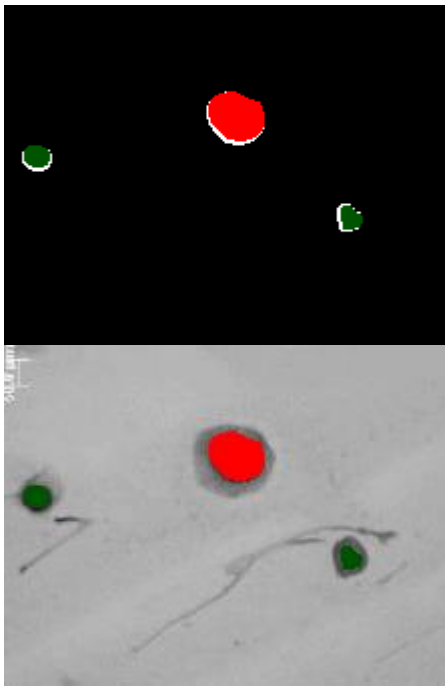

Fig.8 Detection of Cancerous and Non Cancerous Cells in a Binarized & GrayScale Image

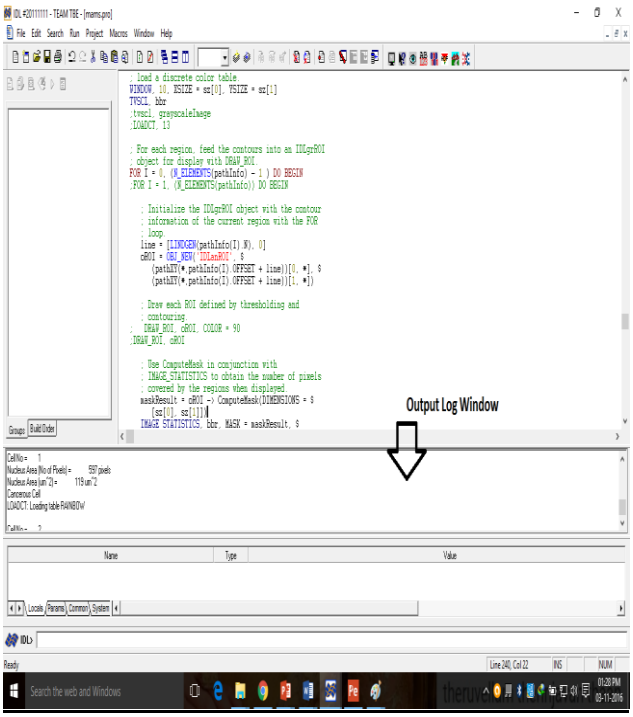

Fig.9. Feature Extraction Results displayed in IDL Output Log Window.

```
Compiled module: Cervical Cancer.

IDL> Cervical Cancer

Cell No =       1

Nucleus Area (No of Pixels) =          597 pixels

Nucleus Area (um^2) =          119 um^2

Diagnosis: Cancerous Cell

Cell No =       2

Nucleus Area (No of Pixels) =          160 pixels

Nucleus Area (um^2) =          32 um^2

Diagnosis: Non-Cancerous Cell

Cell No =       3

Nucleus Area (No of Pixels) =          142 pixels

Nucleus Area (um^2) =          28 um^2

Diagnosis: Non-Cancerous Cell
```

Fig.10. Detailed Feature Extraction Result of an Output Log Window

2.6 Classification:

Process:

The objective of the classification is to categorize the cervical cells into cancerous (Abnormal Cell) and non-cancerous cell (Normal Cell) based on the extracted feature (Area value) of the nucleus by using given table values (Table.1).

Result:

S.No	Cell	No of Pixels inside the Nucleus	Nucleus Area Value (um^2)	Cancerous Cell Range (Area below 50um^2)	Non Cancerous Cell Range (Area above 50um^2)	Display Color
1	Cell 1	597	119 um^2	Cancerous Cell		Red
2	Cell 2	160	32 um^2		Non-Cancerous Cell	Green
3	Cell 3	142	28 um^2		Non - Cancerous Cell	Green

Table.1: Classification of Cancerous Cell &Non Cancerous Cell.

Resulting Chart

According to the previous section table.1 Classification of the Cancerous and Non Cancerous

Results based on the Chart (fig.11) is given below.

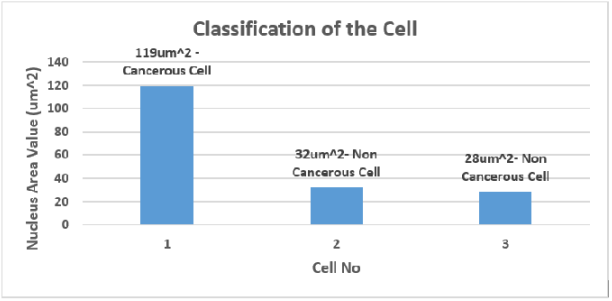

Fig. 11. Classification Chart

In the above Figure.11 shown the results of Cancerous cell cording to t

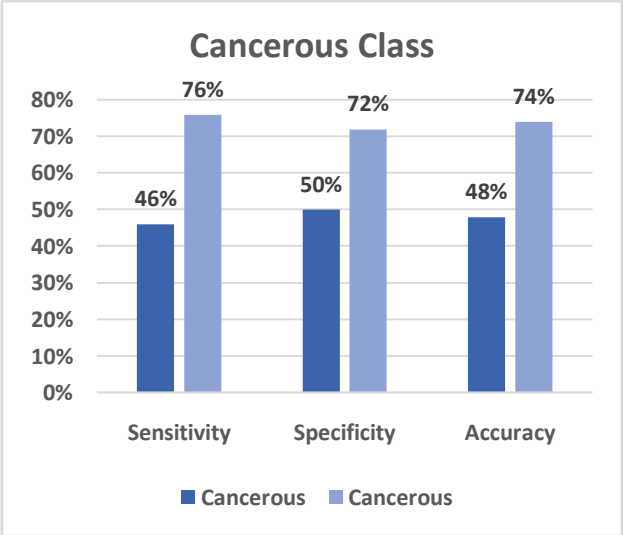

Fig.12. Cancerous Class Analysis Graph

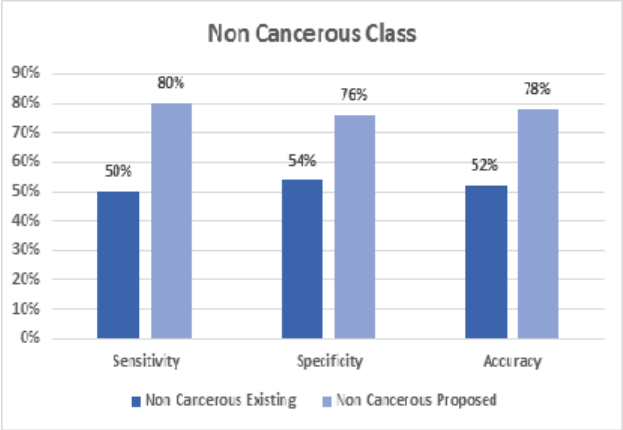

Fig.13. Non-Cancerous Class Analysis Graph

3. Comparison Analysis:

Our proposed work (Nucleus Area Value based Cancer Detection Analysis System) is compared with the Existing system ((Nucleus Mean Intensity Value based Cancer Detection Analysis System – M.V.Srinath,et al(2013)) by using the statistical parameters such as Sensitivity, Specificity & Accuracy. Our Proposed System gave 74%% Accuracy than the Existing System 48% (Cancerous Class) and the Proposed System gave 78% Accuracy than the Existing System 52% (Non-Cancerous Class). The Comparison table and graphical representation is shown as in given in table.2& Figure 12 &13..

Images Details:

Total : 150 Images – 75 Cancerous Images + 75 Non Cancerous Images

Cancerous Class:

75 Cancerous Images : 50 Images (Testing) + 25 Images (Training)

Non Cancerous Class:

75 Non CancerousImages : 50 Images (Testing) + 25 Images (Training)

Class Predicted	Existing/ Proposed	TP	TN	FP	FN	Sensitivity	Specificity	Accuracy
Cancerous	Existing	11	13	13	13	46%	50%	48%
	Proposed	19	18	7	6	76%	72%	74%
Non Cancerous	Existing	12	14	12	12	50%	54%	52%
	Proposed	20	19	6	5	80%	76%	78%

Table. 2 Comparison Analysis for Proposed and Existing System.

Conclusion

The distinctive differences of color intensity distributions between normal and cancerous cells have been successfully applied to be used to characterize cancerous cervical cancer cells. To achieve the objective of this study, level set and mathematical morphology have been used as image processing methods. Test result shows, that the detection system in this study is able to differentiate between normal and cancerous cells by using nucleus area based classification. For future works a classification between cancer stages CIN0, CIN1, CIN2 and CIN3 is necessary to be done in order to increase the accuracy of the detection system.

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