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# Cervical Cancer Detection: A Literature Survey

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***Abstract* - Cervical cancer is more common in women and worldwide it is most feared disease. Due to abnormal growth in the cervix cells, cervical cancer occurs and slowly it also spreads to the other organs of human body. Cervical cancer is caused by number reasons like human papillomavirus, using birth control pills, cigarette smoking, etc. In the initial stage, cervical cancer will not show any signs. However, if it is identified in earlier stage, it will be cured successfully. Nowadays, number of computer vision based approaches has been introduced to identify the cervical cancer disease and its stages. Still more research in this domain is ongoing towards getting high accuracy in the disease and stage prediction. In this paper, we studied a detailed literature on recognition of cervical cancer in connection with computer vision approaches.**
***Keywords:*** **Cervical Cancer, Denoising, Classification, Segmentation**

## I. INTRODUCTION

Cervix, a part connecting the uterus with vagina called as womb. In general, cervical cancer is categorized into adenocarcinoma and squamous carcinoma, and squamous cell carcinoma is the most common one and is the fourth most common type of cancer among women [1, 2], and is found in the mid age of women. Though it is preventable, it leads to death in the advance stage. Thus, it should be identified in the early stage. Cervical cancer arises due to uncontrolled development of cervical cells, they will not die instead they continue to divide. Literature reports that HPV virus [3], smoking, and weak immune system, etc are the causes of cervical cancer. However, women without the aforesaid risk factors also affected by cervical cancer and women having these risk factors are not affected by cervical cancer. Although there are number of reasons for cervical cancer, HPV is the important cause and is a class having more than 150 viruses and it spread from one person to another person through skin contacts. Nowadays, death rate due to the cervical cancer is reduced significantly by detecting the cervical cancer in its early stage using the pap smear test. However, Pap smear examination is always not accurate due to manual errors and it also time consuming one. To address that over two decades researchers are working in this domain and till they continue research towards better accuracy and time cost.

## II. LITERATURE SURVEY

In this study, detailed review on machine learning and computer vision based approaches used to identify the cervical cancer is studied and we also studied advantages and disadvantages of those approaches in terms of accuracy, storage and time cost.

Table I Literature survey on cervical cancer using computer vision techniques

| Author name | Methods used | Description |
|---|---|---|
| Xu *et al.*, [5] | Pyramid histogram for Local Binary Patterns, L*A*B color space and oriented gradients and convolution neural network | Deep features based convolutional neural network is compared with seven classic classifiers fed with hand crafted pyramid features for classification of cervigram images.<br><br>Conclude that convolution neural network outperformed the existing seven classic neural networks for cervigram images. |
| Taneja*et al.*, [6] | Neighborhood - Concentric filtering, Gray level co-occurrence matrix, Neural network relevance vector machine | Neighborhood concentric filter is used for denoising. From the denoised image, segmentation operation is performed in an enhanced manner using optimum weight updating with Multi-Level set estimates. From Segmented region of interest gray level co-occurrence matrix and geometrical features like cell size, area, maximum intensity and cell intensity are calculated and are fed to neural network based RVM classifier for the |

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| | | classification of abnormal and normal cervical images |
| Selvathi *et al.,* [7] | Deep learning and Support Vector Machine | In order to avoid the overlapping of cell issues, deep learning method tailed by support vector machine is employed. First one segregate the nucleus, cytoplasm and background from input image and second one classifies the cervical cells into normal and abnormal based on the computed shape features from nucleus. |
| Bora *et al.,* [8] | Generalised Gaussian Density descriptors of Ripplet Type I transform is employed to capture the color and texture information and the 2nd order statistics of Gray Level Co-occurrence Matrix is also employed as texture feature. The size of the proposed feature is 121. | Cervical dysplasia is identified from the images of pap smear investigation using ensemble classification method. First, Cervical dysplasia is categorized into normal and abnormal then it is also categorized into intraepithelial lesion or intraepithelial malignancy, High and low grade Squamous Intraepithelial Lesion.<br><br>First, Haarwavelets are applied in the initial stage. Next to remove the noises median filter is applied and the background is removed by adopting bit plane slicing. Later RBC is removed by considering that RBC take red color only and RBCs are extracted by using k-means approach then the RBC is removed. By performing morphological operation inflammatory cells are removed. For automatic segmentation process of nuclei, Maximally Stable Extremal Region technique is adopted. shape features like area, eccentricity, perimeter, circularity and compactness of nucleus are extracted. 50 texture features of nucleus is computed. Among 50, 6 descriptors are computed from first order statistics of histogram and are Mean, Kurtosis, Variance, Skewness, Entropy and Energy. The remaining 44 descriptors are calculated from 2nd order statistics of GLCM and are Homogeneity, Angular second moment, Sum of Squares, Correlation, Inverse difference moments, etc. Least Square Support Vector Machine, Multilayer Perceptron and Random Forest approaches are integrated through biased majority voting method to get the final output. The system categorizes training and testing is employed based on 5 fold cross validation approach. |
| Iliyasu, *et al.,* [9] | Quantum machine learning, Fuzzy k-NN, quantum-behaved PSO | The colour, geometry and texture features of size 17 is computed and to choose the finest subset descriptors, quantum-behaved particle swarm optimization (PSO) approach based fuzzy k-nn is used and the approach is called as Q-Fuzzy approach and the method gives better accuracy. |
| Singh *et al.,* [10] | Watershed segmentation, Thresholding, Morphological operations. | Presented a methodology for the segmenting the nuclei of cervix cells in pap smear image based on watershed segmentation. |
| William *et al.,* [11] | -- | A detailed review for cervical cancer analysis is performed. Various segmentation algorithms, classification approaches and feature extraction and representation for accurate identification of cervical cancer is discussed.<br><br>Advantages and disadvantages of each approach is discussed which will lead the researchers in this domain towards correct direction. |

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| Mukhopadhyay, *et al.,* [12] | Hilbert transform Support Vector Machine | In this paper, the researchers make use of empirical manner decomposition to characterize cervical cancer tissues from normal one using elastic scattering spectroscopy. SVM is used in the classification stage. |
| Kudva*et al.,* [13] | Standard deviation filter and Curvilinear structure | This work introduced standard deviation filter for specular reflection detection and curvilinear structure enhancement. for cervix region segmentation. |
| Sornapudi*et al.,* [14] | Super pixel method convolutional neural network | Super pixels approach using linear iterative clustering algorithm is suggested for segmentation and convolutional neural network is used for training |
| Zhao *et al.,* [15] | multi-instance extreme learning machine | Multi-instance extreme learning machine is used for cervical cell classification based on cytology morphology, nuclear chromatin pathology and region intensity |
| Manogaran*et al.,* [16] | Bayesian hidden Markov model, Gaussian mixture clustering | DNA copy number modified across genome is modeled using Bayesian hidden Markov model with Gaussian Mixture Clustering method and the DNA copy number modified is used as an attribute to find the cervical cancer. |
| Bhargava, *et al.,* [17] | Histogram of gradient (HOG) Support Vector Machine, K nearest neighborhood neural network | HOG feature is extracted from the segmented cervical cells and is classified by using SVM, k-nearest neighboring and artificial neural network to categorize the cervical cells into cancer and cancerous.. |
| Hemalatha*et al.,* [18] | Edge Detection with Fuzzy System | Cervical images of pap smear are segmented into cytoplasm and nucleus using the improved edge detection technique based on fuzzy approach. They suggested that the proposed segmentation technique gives very better accuracy in the identification cervical cancer. |
| Zhao *et al.,* [19] | K-Means, Max flow / min cut algorithm, Voronoi based dump division | Unsupervised segmentation technique without demanding the training data for overlapping the cervical images of pap smear is introduced. |

## III. CONCLUSION

Screening process undergone for cervical cancer manually has higher issues of producing false negative rates in Pap smear test. Hence an alternate method came into existence called automated computer based technique to increase accuracy for testing cervical smears. Better performances were shown by various researchers in classifying normal cells and abnormal cells by suggesting new approaches for segmentation or classification or feature extraction or in all. However, still miles of research has to be carried out in this domain to improve the level of accuracy, speed and storage cost.

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