Survey Paper on Cervical Cancer Detection Through Artificial Intelligence Techniques

R. Rajpriya*1, Dr.M.S.Saravanan*2

Research scholar,Department of Computer Science,Bharathiar University,Coimbatore,India.
Department of Computer Science and Engineering,Savitha University, Chennai,India.

Abstract:

Cervical cancer is one of the gravest threats to women's lives. Cervical cancer is the second most common cancer among the females after breast cancer. It is estimated that over a million women worldwide currently affected with cervical cancer.World Health Organization estimates every year 1,22,844 women are diagnosed with cervical cancer and 67,477 women die from the disease. There are several tests that can effectively detect Pre-cancer. Artificial intelligence (AI) concepts, techniques, tools have been utilized in medical applications in improving their effectiveness, productivity and consistency. The precision in distinguishing a cancerous structure from a benign structure has the potential to immediately improve health outcomes in one of our more pressing diseases. Automating the cancer diagnosis process can play a very significant role in reducing the number of cancer diagnosis is semiautomatic and is prone to human error and time consuming. A computer system that performs automatic grading can assist pathologists by providing second opinions, reducing their workload, and altering them to cases that requires closer attention, allowing them to focus on diagnosis and prognosis. This paper discussed the recent advances and future perspectives in relation to cervical cancer detection.

Keywords- *Cervical cancer, Pap smear test, Artificial Intelligence Techniques.*

I.INTRODUCTION

Cancer can be described as an abnormal growth of cells. Cancer of the cervix involving the squamous cells of the cervix(commonly referred to as the mouth of the uterus). At a more advanced stage,the cancer cells spread to surrounding tissue such as the bladder and even spread to distant tissue such as bones and lungs, through the blood stream. The cervical cancer is caused by the Human Papilloma Virus(HPV). The virus can damage cells in the cervix namely, squamous cells and glandular cells that may develop into squamous cell carcinoma (cancer of the squamous cells) and adenocarcinoma (cancer of the glandular cells)respectively. Pap test is one of the early diagnosis that should be done to reduce the mortality rate related to cervical cancer. Nevertheless, low accuracy, sensitivity and specificity become a problem in diagnosing cervical cancer using the pap test. The most widely used methods are Pap smear,Colposcopy, Liquid based cytology(LCB), Visual Inspection with Acetic acid(VIA), biopsy,Endocervical Curettage(ECC)[2]. The manual screening methods suffer from accurate result and time consuming. The computerized methods are used for differentiating the normal and abnormal cells of the cervical cancer.

II.LITERATURE SURVEY

1. *Specular reflection detection in uterine cervix images:*

Authors: D.B.Patil, S.B.Patil, B.Salokhe,R.T.Patil

Specular reflection, also known as regular reflection, is the mirror-like reflection of waves, such as light, from a surface. In this process, each incident ray is reflected at the same angle to the surface normal as the incident ray, but on the opposing side of the surface normal in the plane formed by incident and reflected rays. The result is that an image reflected by the surface is reproduced in mirror-like (specular) fashion[Fig.1].The law of reflection states that for each incident ray the angle of incidence equals the angle of reflection, and the incident, normal, and reflected directions are coplanar. SR frequently appear in photographic images and interfere with numerous computer vision tasks such as segmentation, object recognition, shape from shading and binocular stereo.

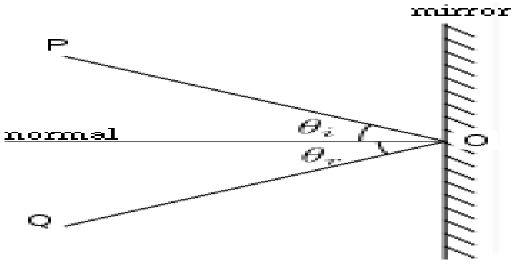

Fig.1 Specular Reflection

When light hits a surface, there are three possible outcomes.[2] Light may be absorbed by the material, light may be transmitted through the surface, or light may be reflected. Materials often show some mix of these behaviors, with the proportion of light that goes to each depending on the properties of the material, the wavelength of the light, and the angle of incidence. For most interfaces between materials, the fraction of the light that is reflected increases with increasing angle of incidence .Reflected light can be divided into two sub-types, specular reflection and diffuse reflection. Specular reflection reflects all light which arrives from a given direction at the same angle, whereas diffuse reflection reflects that light in a broad range of directions.

The authors D.B. Patil, S.B. Patil, B. Salokhe,R.T. Patil in [3], SR-technique is improved for effectively detecting over cervicographic images. It implemented with images of acetowhite(AW)lesions, the ability to monitor and detect the changes of cervical cells. SR-technique used with edge detection block finds edges by looking the gradient of the input image. Because of edge detection method is more robust to noise, and more likely to detect true weak edges. SR appear as bright spots heavily saturated with white light. It acts like mirrors reflecting the light from the illumination surface.As a result, the complexity of SR-technique is decreased as well as extracting texture measures of cervix images.

2.*Expectation-MaximizationAlgorithm on probabilistic segmentation methods*

Authors: Abhishek Das, Avijit Kar, Debasis Bhattacharyya

The EM algorithm is an efficient iterative procedure to compute the Maximum Likelihood(ML) estimates the presence of missing or hidden data. The EM iteration alternates between performing an expectation(E)step, which creates a function for the expectation of the log-likelihood evaluated using the current estimate for the parameters, and a maximization(M) step,which computes parameters maximizing the expected log-likelihood found on the E-step[Fig.2].The EM algorithm proceeds from the observation that there is a way to solve these two sets of equations numerically. One can simply pick arbitrary values for one of the two sets of unknowns, use them to estimate the second set, then use these new values to find a better estimate of the first set, and then keep alternating between the two until the resulting values both converge to fixed points.

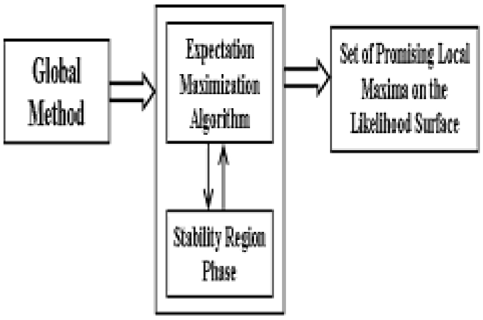

Fig.2 EM Algorithm

The authors Abhishek Das, Avijit Kar, Debasis Bhattacharyya in[4],proposed EM method, estimates the presence of missing or hidden data. The method can discover the likelihood at each iteration. EM-algorithm using with acetowhite lesions of cervix, maximizes the accuracy or to assess and performs the regions of high sensitivity and high specificity.

3. *Principal Component Analysis for spectroscopic diagnosis*

Authors: Melissa C.Skala, Changfang Zhu, Annette GendreonFitzpatrick

Principal component analysis is a statistical procedure uses an orthogonal transformation to convert a set of correlated variables into a set of values of linearly uncorrelated variables. PCA was employed as a dimensionality reduction technique for visualizing and processing high-dimensional datasets. PCA is used to quantify the distance between two or more classes by calculating center of mass for each class in principal component space.PCA can supply the user with a lower-dimensional picture, a projection of this object when viewed from its most informative viewpoint. This is done by using only the first few principal components so that the dimensionality of the transformed data is reduced. PCA is mathematically defined as an orthogonal linear transformation that transforms the data to a new coordinate system such that the greatest variance by some projection of the data comes to lie on the first coordinate (called the first principal component)[Fig.3], the second greatest variance on the second coordinate, and so on. it has been used to quantify the distance between two or more classes by calculating center of mass for each class in principal component space and reporting

Euclidean distance between center of mass of two or more classes.

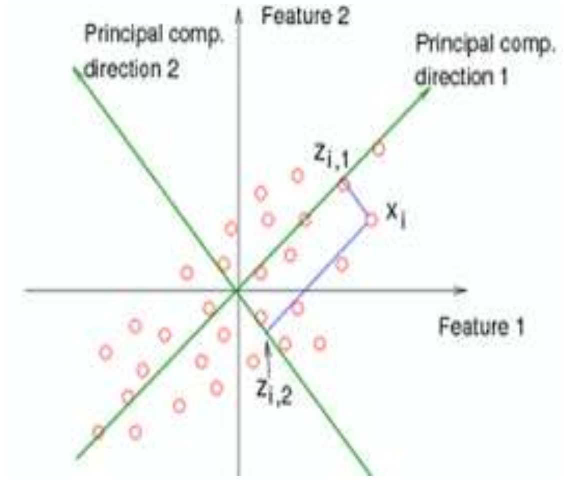

Fig.3 Principal Component Analysis

The authors Melissa C.Skala, Changfang Zhu, AnnetteGendreon-Fitzpatrick in[5], intend to study the Principal Component Analysis(PCA) transforms each spectrum into a few orthogonal principal components. In this method, algorithm extract intensity-wavelength points in the spectrum. This algorithm used to retain a percentage of the variance of the original spectral dataset. Here discover the maximal differences between dysplasia and normal tissues in the corresponding spectrum.

4. *Fuzzy Clustering based Image Segmentation:*

Authors: Jyotismita Talukdar,Chandan,Kr.Nath, P.H.Talukdar

Clustering is a process which partitions a given data set into homogeneous groups based on given features such that similar objects are kept in a group whereas dissimilar objects are in different groups. It deals with finding structure in a collection of unlabeled data. An important component of a clustering algorithm is the distance measure between data points.This algorithm works by assigning membership to each data point corresponding to each cluster center on the basis of distance between the cluster center and the data point[Fig.4]. More the data is near to the cluster center more is its membership towards the particular cluster center. Gives best result for overlapped data set and comparatively better then k-means algorithm. Unlike k-means where data point must exclusively belong to one cluster center here data point is assigned membership to each cluster center as a result of which data point may belong to more than one cluster center.

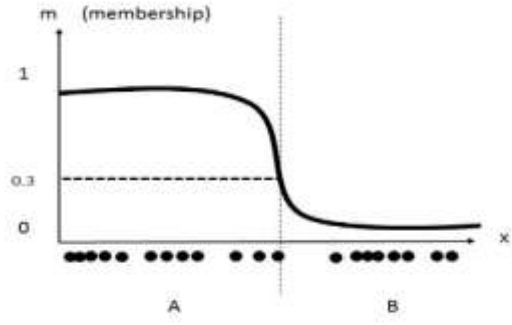

Fig.4 Clustering analysis

Theauthors Jyotismita Talukdar,Chandan, Kr.Nath, P.H.Talukdar in[6], proposed FCM algorithm, extracts the characteristics of the cell nuclei are morphometric feature, densitometric feature, colorimetric feature, and textural features. FCM algorithm enable to detect arbitrary shaped clusters, minimizing the high dimensionality of Pap smear images, and to generalize the shape analysis with some concrete and invariant shapes.

5. *Discriminant Analysis for In Vitro Detection of cervical cancer*

Authors: Anita Mahadevan-Jansen,Michele Follen Mitchell, Nirmala Ramanujam

Discriminant analysis is a tool to assess the adequacy of a classification. It is used to assign objects to one group among a number of groups. It is used to determine which predictor variables are related to the dependent variable and to predict the value of the dependent variable given certain values of the predictor variables. It is useful in determining whether a set of variables is effective in predicting category membership.Discriminant analysis works by creating one or more linear combinations of predictors, creating a new latent variable for each function. The first function created maximizes the differences between groups on that function. The second function maximizes differences on that function, but also must not be correlated with the previous function. This continues with subsequent functions with the requirement that the new function not be correlated with any of the previous functions.

Theauthors Anita Mahadevan-Jansen,Michele Follen Mitchell, Nirmala Ramanujam in[7],proposed Fisher's Discriminant Analysis(FDA) used as a classification technique to discriminate between SIL and non-SIL. The FDA yields optimal results for normally distributed data when the prior probability, which accounts for the differences in sample size of the two groups and the cost of misclassifying a sample in a particular group included.

6. ***Support Vector Machine for Image Classifications***

Authors: M.Anousouya Devi,S.Ravi, J.Vaishnavi S.Punitha

Support vector machines are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis. A Support Vector Machine (SVM) is a discriminative classifier formally defined by a separating hyperplane. In other words, given labeled training data (supervised learning), the algorithmoutputs an optimal hyperplane which categorizes new examples. In two-dimensional space this hyperplane is a line dividing a plane in two parts where in each class lay in either side. Support Vector Machine performs classification by finding the hyperplane that maximizes the margin between the two classes. SVM analysis should produce a hyperplane that completely separate the vectors into two non-overlapping classes[Fig.5]. SVM handles a kernel function to map the data into a different space where a hyperplane cannot be used to do the separation. Kernel function transform the data into a higher dimensional feature space to make it possible to perform the linear separation.

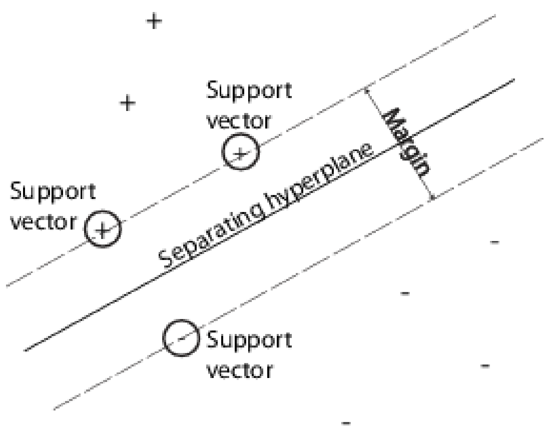

Fig.5 Support Vector Machine

The authors M.Anousouya Devi,S.Ravi, J.Vaishnavi S.Punitha in[8], proposed the support vector machine used to obtain a new pattern strategy for the detection of cervical cancer. SVM removes the artifacts from the epithelial cells. The support vector machine is used as the classifier for the normal and abnormal Cervical Intraepithelial Neoplasia(CIN). SVM classifier is used to separate the multiple clusters with a set of hyperplanes. SVM evaluates the cytological information by giving a better performance of 71% than the other methods used.

III.CONCLUSION

In this paper, we have been reviewed about detection of cervical cancer. Lot of research work has been carried in this field to develop an efficient artificial intelligence technique for detecting cervical cancer. Finally, this study may promote the development of new artificial intelligence techniques are implementing to get a better result for detecting cervical cancer.

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