Review on Detection of Melanoma Skin Cancer Using Machine Learning and Image Processing Algorithms

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***Abstract*- Melanoma is the most dangerous type of skin cancer. It is primarily caused by exposure to harmful UV radiations (artificial or natural). This disease is totally curable if detected at an early stage, but, if it is detected at a later stage, it can be fatal. Computer technology can play a vital role in the field of medicine, using technology like machine learning we can detect this disease at an early stage and reduce the number of fatalities. In this paper, we will see that how computer technology can be applied in early detection of the mentioned disease so that the number of fatalities can be reduced.**

I. INTRODUCTION

Cancer has become one of the most dangerous diseases in today's world. Death rate due to this disease is increasing exponentially. One of the most dangerous type of cancer has been identified as the Melanoma Skin Cancer which is caused mainly due to exposure to radiations such as UV whose main source is sunlight and other sources include different kinds of lamps and electronic equipment.

About 1, 32,000 cases of Melanoma Skin Cancer occur globally each year. Accurate detection of this cancer can only be done with a Biopsy. Punch Biopsy, Excisional Biopsy and Incisional Biopsy are the procedures used for the same. These methods are time consuming and can be painful for the patient. If this cancer is detected at an early stage it can be treated completely using Chemotherapy and other medical techniques.

Computer aided detection of Melanoma Skin Cancer can be a fast and efficient alternative to detect this disease at an early stage. Machine Learning and Image Processing are the fields of computer technologies that can deal with these kinds of applications of computers. There are different steps involved in the process of detection of the disease using the above-mentioned technologies. We will be seeing those steps in this paper.

II.REVIEW

As early detection is very important in this field of medicine, several researches on this topic have already been completed and several companies have invested their time and money in early detection and successfully applied this technology in the industry. Many techniques of Machine Learning and Image Processing have been applied and successful results were obtained from the same. There are many different algorithms that can be used to detect melanoma from images.

Different techniques have different requirements of the training data set and the features required to train the classifiers used in different techniques. All the different techniques hold different percentages of efficiency and accuracy. We shall see some of the techniques which can be used in the detection of the disease in this paper.

III.DETECTION OF MELANOMA SKIN CANCER

The detection of melanoma skin cancer can be very fast and efficient if done with the help of image processing and machine learning technologies instead of the traditional clinical methods, which may also have human errors and are time consuming and painful to the patient. So the prior method can be used to increase the efficiency. It comprises of several steps which are pre-processing, segmentation, feature extraction, classification.

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be

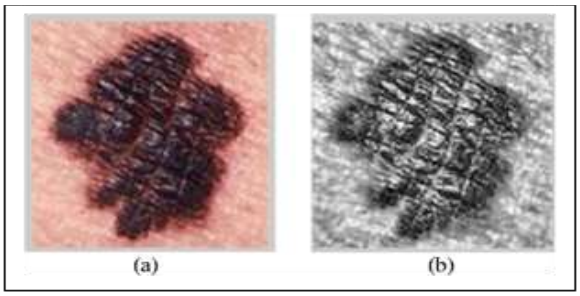
defined. Do not use abbreviations in the title or heads unless they are unavoidable.

A. Preprocessing

Image preprocessing is a process which is performed on the raw or original image to obtain the processed image which is enhanced version of the original image. The initial step is to reduce the resolution of the image from high to low, as higher resolution images take more time to process. Next, we go for the enhancement of image by changing the contrast and the brightness of the image. It helps in making the object in the images distinct and unique. Contrast is directly proportional to the difference between a pixel and its neighboring pixels. Brightness can be related to the values of the pixel, higher the brightness higher the pixel value. Then we go for the HSV (Hue, Saturation and Value) color space. HSV helps to get better information for processing of the image.

B. Segmentation

Segmentation is a very important process and it can have a very large impact on the output of the detection process. If the segmentation of the images is accurate then the region affected can be defined well. To get the info about the affected area we need to extract the pixels present in that area. Therefore, in segmentation the affected part is



segmented from rest of the skin. Each pixel in the segment is associated with specific properties like color, intensity and texture (their values), which are then used for proper and accurate analysis of the region. There are various techniques used for segmentation, like, Thresholding, Clustering Methods, Motion and Interactive Segmentation, Compression-based Methods, Histogram-based Methods, Edge Detection, Dual clustering method, Region-growing methods, Partial differential equation-based methods, Graph partitioning methods, etc. The main classes are classification based, region based, edge based and hybrid methods.

C. Feature Extraction

Feature Extraction is the stage in which the features of the segmented area are extracted and given as input to the classifiers. The features which are extracted should be measurable and highly sensitive. It means that the features must have high co relation with cancer and high probability of positive or negative response considering the actual response of the image.

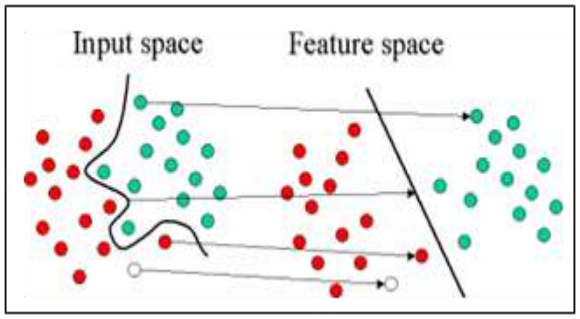
According to the features which are analyzed in dermoscopy following are performed.

The various features are extracted based on the following methods:

The ABCD- rule of dermatoscopy, Menzies method, The ELM 7-point checklist, Texture and Pattern Analysis etc.

The ABCD rule is a type of semi-quantitative analysis method in which 4 dermatology criteria are used which are Asymmetry, Border, Color and Different structures.

The Menzies method is a simplified method for detection of the disease. In this method, both positive and negative features are extracted and analyzed and are further used for



classifying the disease. Negative features include the symmetry of the pigmentation pattern and Single color. The positive features include Blue-white Veil, Multiple Brown dots, Pseudopods, Radial streaming, Scar-like depigmentation peripheral black globules, multiple colors etc. Similarly ELM 7-point checklist is also a diagnostic aid which includes the analysis of following characteristics Change in size of lesion, Irregular pigmentation, Irregular border, Inflammation, Itch or altered sensation, Larger than other lesions (diameter >7mm), Oozing/crusting of lesion.

Similarly, various features are extracted from the images using algorithms, based on various diagnostic methods as mentioned above and then they are fed into the classifiers for further classification.

D. Classification

The last stage in the detection of melanoma skin cancer using machine learning is the classification stage. In this stage the extracted features of the images are used to train the classifiers and then the trained classifiers are used to classify the test objects (the new images which are to be tested). There are many classification models available, some of the models available are:

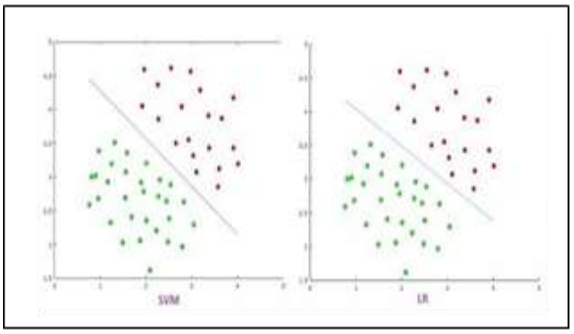
- Perceptron
- Naive Bayes
- Decision Tree
- Logistic Regression
- K-Nearest Neighbor
- Artificial Neural Networks/Deep Learning
- Support Vector Machine, etc.

Apart from the above-mentioned models, there are different ensemble methods such as Random Forrest, Bagging, AdaBoost etc.

Perceptron was the first classification algorithm that was written at Cornell Aeronautical Laboratory in 1957. It is an algorithm for supervised learning of binary classifiers. Hence, it can be used for classification of melanoma images by learning of the features which were extracted in the previous stage. But, there are many other classifiers available now which are more advanced than the perceptron which are mentioned above. One of the advanced classifier is SVM (Support Vector Machine) classifier.

SVM is a very efficient and accurate classifier as compared to the other classifiers. It is also use to train the images and then specify them as positive or negative according to the data. So, in the case of melanoma detection also it can be used for efficient and accurate detection of melanoma based on the features of the test images. We can classify the test image as positive for the presence of melanoma and negative for its absence. We can also classify the positive images of melanoma as malignant or benign melanoma using this classifier.

According to studies it was found that SVM was very efficient in the case of image recognition or



Classifications based on image datasets, hence SVM would be the best suited classifier for the task.

In a comparison of SVM and logistic regression, SVM wins because of the difference in the loss functions of both the classifiers. The Logistic loss (LR loss func.) diverges faster than the hinge loss (SVM loss func.). SVM maximizes the margin between the points which are closest to the decision boundary whereas Logistic Regression maximizes the margin between the posterior class probabilities. Hence, the solution given by SVM is fare as compared to the one given by LR model.

Hence, in important and critical tasks such as the detection of disease like melanoma skin cancer we can use SVM classifier as it is accurate, efficient and dependable.

IV.CONCLUSION

So, from this paper, we can conclude that Computer Aided detection of Melanoma Skin cancer using ML and Image Processing can be of great use to the medicine field. It will help in the early and accurate detection of the disease and hence it is detected early the probability of curing the disease will increase which may then lead to the decrease in the number of fatalities due to this disease. Machine Learning and Image Processing algorithms can help to overcome the limitations of the humans in these kinds of fields, and hence lead to better development of more technologies in other fields also.

REFERENCES

[1] https://towardsdatascience.com/support-vector-machine- vs-logistic-regression-94cc2975433f

[2] Cancer Facts and Figures 2017. American Cancer Society. Available: [online] http://www.cancer.org/acs/groups/content/@edit

orial/documents/docu ment/acspc-048738.pdf. Accessed May 10, 2017.

[3] Saranya, V.Radha. Melanoma Skin Cancer Detection: A Review, International Journal of Advanced Studies in Computer Science and Engineering IJASCSE, Volume 3, Issue 8, 2014 page 18-24

[4] Shivangi Jain, Vandana Jagtap, Nitin Pise, Computer Aided Melanoma Skin Cancer Detection using Image Processing, International Conference on Intelligent Computing, Communication and Convergence (ICCC-2015) page 735-740

[5] Eliezer Flores, Jacob Scharcanski. Segmentation of melanocytic skin lesions using feature learning and dictionaries, Expert Systems with Applications 56 (2016) Page 300-309.

[6] Roberta B. Oliveira, Mercedes E. Filho, Zhen Ma, Joao P.Papa, Aledir S.Pereira, Joao Manuel R.S. Computational methods for the image segmentation of pigmented skin lesions: A review. Computer methods and programs in biomedicine 131 (2016) page 127-141

[7] S. Mustafa, A. B. Dauda and M. Dauda, "Image processing and SVM classification for melanoma detection," 2017 International Conference on Computing Networking and Informatics (ICCNI), Lagos, 2017, pp. 1-5.doi: 10.1109/ICCNI.2017.8123777D. Saranya and V.Radha, Melanoma Skin Cancer Detection: AReview, International Journal of Advanced Studies in Computer Science and Engineering IJASCSE, Vol 3. Issue 8, 2014

[8] Martin Law, A Simple Introduction to Support Vector Machines, Lecture for CSE 802, Department of Computer Science and Engineering, Michigan State University

[9] D. Gautam and M. Ahmed, "Melanoma detection and classification using SVM based decision support system," 2015 Annual IEEE India Conference (INDICON), New Delhi, 2015, pp. 1-6. doi: 10.1109/INDICON.2015.7443447