IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 4, March 2025

Early Detection of Skin Cancer - Solution for Identifying and Defining Skin Cancers using AI

Ms. Shahela Saleem Momin, Mr. Rohit Anil Kautkar, Mr. Vaibhavshriram Walke
Guru Gobind Singh Polytechnic Nashik, Maharashtra, India
shahela.momin@ggsf.edu.in, rohit.kautakr@ggsf.edu.in, vaibhav.walke@ggsf.edu.in

Abstract: *Skin Cancer is seen as one of the most hazardous forms and common types of cancer in the world. Each year there are approximately more than 10 million new cases of skin cancer recorded globally - this number is alarming. The survival rate is very low if diagnosed in later stages. Artificial Intelligence can play a very important role in using Medical Image Diagnosis to detect this disease in early stages. However, the AI systems for the classification of different skin lesions, are still in the very early stages of clinical application in terms of being ready to aid in the diagnosis of skin cancers. Moreover, there are not many players who are doing research in this direction for conditions specified in the Indian subcontinent. The present paper focusses on advancement in AI solutions in digital image based computer vision for the diagnosis of skin cancer, Some of the challenges and future opportunities to improve the ability to diagnose skin cancer in early stages have also been discussed. Using the HAIS AI tool, we present a computer-aided method, using computer vision and image analysis algorithms for Skin Cancer diagnosis, with improved accuracy. Our solution is focused on the Indian sub-continent and envisions catering to varied business needs that provide flexibility on its adoption and use.*

Keywords: Skin Cancer, Survival rate, AI solutions for Cancer, Diagnosis of skin cancer, Clinical application

I. INTRODUCTION

In the last decades, skin cancer is considered one of the most common and spread cancers around the world. It is extremely important to detect skin cancer in the early stage to reduce mortality. The skin protects the body from infection, viruses such as corona virus, heat and dangerous UV radiation. It also can store water and fat, maintain body temperature, and form vitamin D. The estimation of the World Health Organization is recorded as approximately 132,000 skin melanoma cases per year.

Skin consists of two basic layers; the top layer is called epidermis which is made of flat cells called squamous cells. Basal cells are under the squamous cell, they are round cells. Among the basal cells, there are melanocytes cells which are responsible for pigment for skin colour. Under the epidermis, there is dermis which contains blood cells and glands such as sweat gland. Skin cancer is the abnormal growth of skin cells. This growth can be benign, or it can be malignant such as melanoma. Types of skin cancer are classified according to the type of cells that are subjected to cancer itself. Melanoma skin cancer, Basal skin cancer, and Squamous skin cancer are the most common types of skin cancer..

There are many methods to detect skin cancer. Traditional methods for skin cancer detection such as BIOPSY and naked eye (visual inspection by dermatologists or general practitioners), have several challenges and limitations. BIOPSY is an invasive detection method, it is painful way and time-consuming method, it also may cause the disease to spread out. In cases where a lesion appears suspicious, BIOPSY is required for definitive diagnosis, it may cause scarring, infection, and discomfort for the patient, also it can be expensive. The naked eye is another method where doctors use their eyes and experience to determine if there is a cancer or not. Visual inspection relies heavily on the expertise and subjective judgment of the healthcare provider. The same lesion may be interpreted differently by different practitioners, leading to variability in diagnosis. Errors can occur even when skilled professionals diagnose skin lesions. It can result in both overdiagnosis (identifying benign lesions as malignant) and underdiagnosis (missing malignant lesions), therefore, visual inspection method is a non-dependable way. Inaccuracy in differentiating lesions is considered one of traditional methods limitations. Distinguishing between benign and malignant lesions based solely on

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visual inspection can be challenging, especially for lesions that exhibit atypical features or are in early stages of development. In addition, another limitation is accessibility to dermatologists or specialized healthcare providers in skin cancer diagnosis in many regions, especially in rural or underserved areas. This limitation can lead to delays in diagnosis and treatment. To overcome these limitations, there is ongoing research and development of technologies such as dermoscopy, tele dermatology and computer aided diagnosis systems, which aim to improve the accuracy, efficiency, and accessibility of skin cancer detection. Dermoscopy technique is used for diagnosing skin cancer, it is a non-invasive skin imaging technique. It acquires a magnified image of a region of skin. It has higher accuracy than evaluation by naked eyes.

Digital skin cancer microscopic images can be improved by Machine Learning (ML) and Deep Learning (DL) techniques. Artificial intelligence and adaptation of the technology to the human service are used for different diseases detection. The computer-based detection systems can improve the diagnosis rate of skin cancer in comparison with the traditional methods. The computer aided diagnoses system is identifying the skin images and detects the skin cancer. Image segmentation, features extraction/selection and lesion classification are used for analysing the automated dermoscopic images.

II. LITERATURE REVIEW

Kang Hao Cheong et al proposed an automated skin melanoma detection system with melanoma-index based on entropy features. The system used image pre-processing, image enhancement, entropy and energy feature mining. 600 benign and 600 digital dermoscopy malignant images from benchmark databases were examined. The classification performance assessment with the combination of Support Vector Machine (SVM) and Radial Basis Function (RBF) offered a classification accuracy about 97.50%.

Lyer et al developed hybrid quantum mechanical system to classify cancerous and non-cancerous pigmented skin-lesions. The hybrid approach consisted of quantum classification and classical optimization using gradient descent methods. HAM10000 dataset was used, and the system achieved accuracies of 52% for training and 60% for validation.

Existing System:

computer-aided detection and diagnosis systems for classifying a lesion into cancer or non-cancer. They proposed feature extractor and quadratic support vector machine for skin lesions classification.

ABCD (Asymmetry, Border, Colour and Diameter) rules for automatic skin cancer detection. They used PH^2 standard dataset. Gaussian filter was applied to enhance the images. The contour method was applied for extracting the Region of Interest (RoI) from dermoscopy images.

introduced a system for improving asymmetry classification in PH^2 database using dermatologist-like feature extraction from skin lesion. Early diagnosis of melanoma was performed using asymmetry according to medical algorithms such as ABCD.

Problem Statement:

This paper proposed an intelligent system for skin cancer detection. The implemented system is developed to detect benign and malignant skin lesions. Multiple steps, including pre-processing, different methods for segmentation, features extraction/features selection, and different methods of classification are used for analysing the automated dermoscopic images.

The dermoscopic images dataset used in this paper is from PH^2 Dataset. This dataset is publicly available. PH^2 Dataset is a widely used dataset in the field of dermatology and skin cancer detection. PH^2 dataset contains dermoscopic images that were obtained at the Dermatology Service of Hospital Pedro Hispano (Matosinhos, Portugal) under the same conditions through Tuebinger Mole Analyzer system using 20× magnification. The dermoscopic images are 8-bit RGB colour images with a resolution of 768 × 560 pixels. PH^2 Dataset is a widely used dataset in the field of dermatology and skin cancer detection. PH^2 dataset contains three types of skin diseases, they are Atypical Nevi, Melanoma and Common Nevus

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III. METHODOLOGY

Segmentation

AS and RG algorithms are used for segmentation. Figure 2 shows segmentation using AS, while Fig. 3 shows segmentation using RG. Accuracy for AS is 96% while accuracy for RG is 90%.

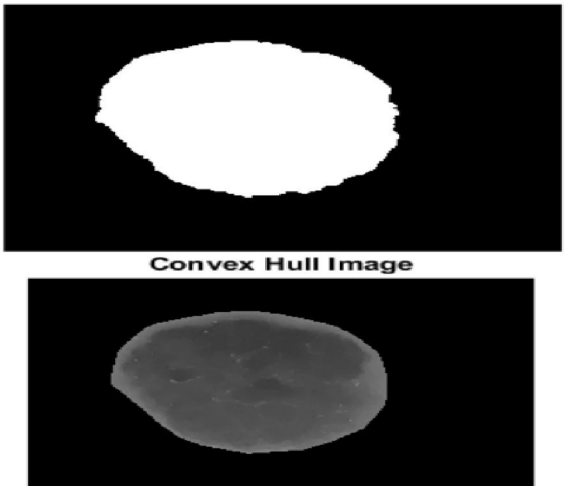

Figure 3

Results show that both AS and RG have their strengths in the segmentation process for skin cancer detection. AS is more efficient than RG due to its flexibility, ability to incorporate prior knowledge and ability to handle complex lesions. AS provides more precise boundaries compared to RG, especially for objects with irregular boundaries or complex shapes. AS is more suitable for a wider range of images. Compared to RG, AS optimizes the contour globally based on the entire image.

It is clear that, AS is simple, more accurate and segment specified region, but it needs to specify mask size. RG can segment image if it is symmetric, but it is slower than AS and it can't segment image if it is Asymmetric.

Classification using NN and SVM

The classification results are presented in terms of seven metrics: precision, accuracy, sensitivity, specificity, F1 score, Jaccard and MCC.

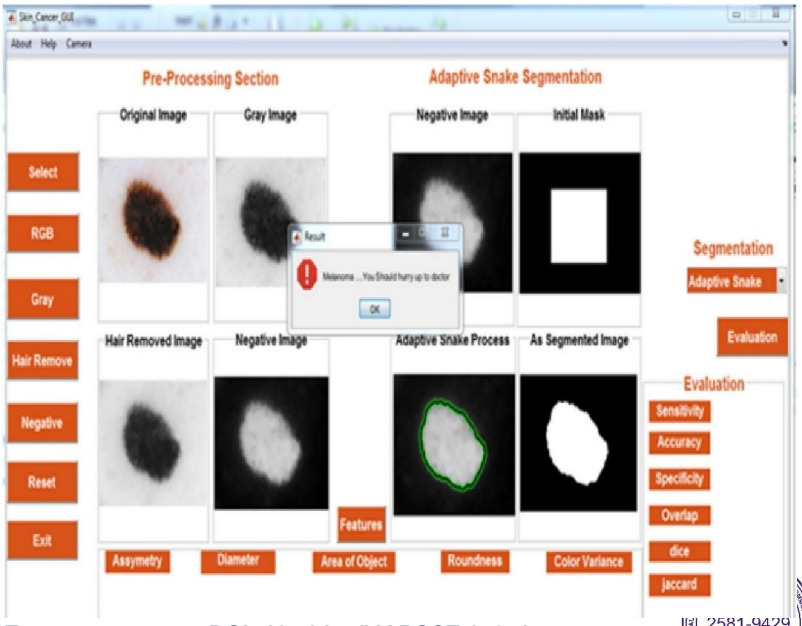

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Figure 4 shows GUI for the proposed system. Table 1 summarizes the performances obtained by the proposed system in comparison with the results from literature review, including the methods used, datasets, algorithms and results achieved for the diagnosis of skin cancer dermatoscopic images. It is important to notice that a comparison would imply implementation of all methods and validation with the same dataset. However, it could be noticed that the obtained results are comparable with the best results in the literature.

As shown in Table 1, the proposed system with ANN algorithm has maximum efficiency [accuracy (94%), precision (96%), specificity (95.83%), sensitivity (recall) (92.30%), and F1-score (0.94)] compared to the proposed system with SVM algorithm. Also, the proposed system with ANN algorithm has maximum efficiency compared to other research using PH2, Hospital Pedro Hispano (PH2), HAM10000, Dermo fit, and ISIC datasets.

The proposed methodology outperforms the previously published result. Consistent classification performance in all the metrics across various classifiers indicates the suitability of the proposed features and methodologies.

Therefore, the proposed system is easy to use, time consuming, enables patients to monitor remotely and make early detection for skin cancer and has high efficiency. It also improves skin cancer's diagnosis rate. Automated early detection system for skin cancer dermoscopic images using artificial intelligent accelerates the time of dermatologists and improves diagnosis performance.

IV. CONCLUSION

In this work, automated early detection system for skin cancer dermoscopic images using artificial intelligent is presented. The proposed system accelerates the time of dermatologists and improves diagnosis performance. All the images in the PH^2 database are used, divided into 80 common nevus, 80 atypical nevi, and 40 melanomas images. The system was implemented using MATLAB program.

The proposed system is developed to detect benign and malignant skin lesions using multiple steps, including pre-processing, different methods for segmentation, features extraction/features selection, and different methods of classification are used for analysing the automated dermoscopic images.

In the future work, the proposed system can be operated on a real-time diagnosis application after obtaining required approval and declarations. Additionally, more methods such as another ML models or deep learning models will be implemented aiming to enhance the performance level. Other available datasets can be used to test the suggested framework's ability to categorize skin cancer.

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