Review of an Automated Clinical Decision Support System for Skin Abrasion Recognition and Classification

Khushmeen kaur brar¹ & Ashima Kalra² & Piyush Samant³

¹Student, Department of Electronics and Communication, Chandigarh Engineering College, Mohali, India.
²Associate professor, Department of Electronics and Communication, Chandigarh Engineering College, Mohali, India.
³Assistant Professor, Chandigarh University, Gharuan

Received: January 25, 2019
Accepted: March 11, 2019

Abstract: Skin cancer prevalence rates have been strengthening constantly. This is absolutely the fatal classification of ailment for the reason that it is greatly supposable to expand to further body parts with the exception of analyzing and medicating prematurely. Premature observation of skin cancer demands computer assisted determination. There is an essential requirement of Computer Aided Diagnosis for the practitioners that are not well trained. The incentive of this paper is to recapitulate all manners of experimentation that have been brought about in skin cancer recognition. The optimum focus of the very paper is to proffer a run-through of automatic recognition of skin cancer, miscellaneous steps associated with this diagnosis and differing tactics for timely identification of skin cancer. In this research, we have investigated various techniques and algorithms in use for prematurely diagnosing the skin cancer. This paper aims to highlight the various enhancements that have already been performed and the importance of the CAD system in early diagnosis of the skin cancer.

Key Words: : Computer-Aided Diagnosis, Dullrazor, Texture analysis, PH2 database, Pigment Network, MEDS.

Introduction: Skin cancer is menacing of all sorts of cancers, exempting diagnosed prematurely. The skin cancer can conceivably be segregated into salient categories: benign and the malignant. The malignant condition is more utmost threatening amidst the two. It commences from a cancerous magnification of skin abrasion. Malignant condition of skin cancer is one of the noted cancers from the time being. Conveniently, if skin cancer is diagnosed prematurely, it is operable. The analysts associated with dermatology imaging presume the determination of skin cancer to be computerized in regard to explicit features and color data that are attributes of different classes of skin cancer. It has been exhibited that matlab is an influential tool for diagnosing skin cancer prematurely maneuvering miscellaneous image processing methodologies [1], [2], [3]. The, not many lines code as a program is sufficient for algorithms. Moreover with the help of programming the evaluation amid diverse algorithms turns out to be really uncomplicated and proficient. Because it is hard and subjective for human to diagnose the skin cancer manually, the automatic diagnosis turns out to be the necessary tool. The less qualified general practitioners maneuver automatic diagnosis to obtain accurate results. The use of both computer vision and machine learning provides yet another innovation in accurately diagnosing the skin cancer automatically [4][5]. Even though other technologies offer promising outcomes, dermoscopy is still far and wide exercised tool for skin abrasion diagnosis. The practitioners pursue the proposals of computer-aided diagnosis if they are in doubt in their own diagnosis. This has been proven specifically comparing the performances of ND(Nevus Doctor) and ME(Mole Expert) with that of CAD technology [6]. The most important steps engaged in automatic detection are preprocessing, segmentation, feature extraction and classification. That one may efficiently diagnose skin cancer; miscellaneous segmentation techniques have been introduced. The image segmentation technique put into practice maneuvering matlab followed by STOLZ and TDS algorithm is given by [7]. The frequently used being the otsu’s thresholding[8]. There are a variety of ways by which otsu’s thresholding may possibly be put into practice[9]. The border detection method seems to be another popular segmentation methodology. According to [10] border detection is an imperative step in automatic diagnosis of skin cancer. The author proffered a fast and precise way for identifying skin abrasion boundaries and the methodology.
entails the amalgamation of numerous thresholding techniques. The segmentation of various images can be carried out effectively only if there are no clamors. Most of the skin abrasion images are delimited by hair, distinctively thick hair. The presence of thick hair offers inadequate results. So the algorithm namely Dullrazor has been presented that eliminates unnecessary hair from the imagery[11]. The amalgamation of diverse segmentation techniques is another enhancement in automatic diagnosis of skin cancer[12]. The amalgamation counting two algorithms for categorizing benign and malignant skin abrasion was given by[13][14]. The fusion of region growing and ABCD rule that enhances the segmentation and analytical technique in given in[15]. This was to develop an interface that can support dermatologists in the indicative stage. The paper presented by [16] offer comparison of six segmentation methodologies. The output of automatic segmentation and manual segmentation were also compared. In yet another paper, the amalgamation of co-occurrence matrix and artificial neural network is presented. This is a favorable technique for distinguishing malignant melanoma from melanocytic nevi images[17]. The inclusion of three algorithms pertaining the segmentation of dermoscopic images is another effective proposal[18]. The use of active contour model for segmenting the dermoscopic portrayals is another innovation for classifying the images into benign and malignant form[19]. The segmentation based on pigment network for the skin cancer diagnosis is another powerful tool subjecting to skin abrasions[20][21][22]. The utilization of color space for automatic diagnosis is another proficient methodology[23].

The yet another paper introduced a novel technique for the automatic diagnosis of skin cancer. The technique called MEDS or Mimicking Expert Dermatologists' Segmentation is a robust, precise and exceptionally fast approach for segmenting the melanocytic skin abrasions. The technique can endure minute pictorial imperfections like air bubbles or jagged lighting[24].

The feature extraction is another chief step involved in automated diagnosis of skin cancer[25]. The paper describing the visual features for categorizing benign and malignant skin cancers is defined in[26]. The paper described the procedure to extract features involved all the way through digital image processing and presented the most prominent classification technique. The yet another paper made use of geometrical features for premature diagnosis is a better procedure[27]. The outcomes revealed that the features employed were capable of discriminating ordinary and cancerous abrasions. The features are extracted mostly based on colors, texture[21][28] or both. The approach including color-texture categorization was given in [29] with the inclusion of clamor resistant version of LBP. The fusion algorithm was exercised to pull out color and texture features jointly. The introduction of smart phone application for the diagnosis of skin cancer is another innovation that helps in premature detection. The development of convenient library for diagnosing skin cancer automatically be used as a smart phone application provides additional benefits[30]. The proposed library by means of advanced image processing algorithms, generate outstanding results. The use of deep neural network and deep convolution neural network methodologies for accurate extraction of an abrasion area enhances the diagnostic performance[31][32].

The leading standardized and comparative study sustained the investigation and improvement of various algorithms. For this, the challenge was partitioned into 3 assignments: segmentation of abrasion, feature detection and categorization of disease. The very challenge entailed 593 registrations, 81 pre-submissions and 46 final submissions[33].

The ruling steps comprehended in skin cancer diagnosis are: image acquisition, pre-refining, segmentation, feature extraction, classification.

1.1 Image acquisition: most of the papers made use of popular PH² dermoscopic dataset. This is the public database holding total of 200 skin cancer images. The dataset holds 160 benign and 40 malignant images[34].

1.2 Pre-refining: This is the foremost part of skin cancer recognition. The pre-refining part enhances the condition of the procured image by withdrawing the extraneous clamors, for instance hair on the ground that these clamors might induce miscalculations in categorization. Pre-refining might be accomplished by image magnification, restoration and hair evacuation.

1.3 Segmentation: The subsequent step necessitates image segregation. This process segregates the ROI in distinction to background. In other words the cancerous and the healthy components of portrayal are segregated.

1.4 Feature extraction: The subsequent step necessitates the extrication of features. There are numerous particular features that qualify benign skin cancer from the malignant one. After ascertaining skin abrasion region, the
to proffer contrast amidst diverse methodologies maneuvered to diagnose skin complications.

Sumithra R et al., [41] presented a representation for segregation and categorization of skin abrasion. The segregation was accomplished amidst SVM, KNN, and amalgamation of SVM and KNN.

**Skin cancer detection using texture analysis:**

Md. Nazrul Islam et al.[42] outlined skin cancer recognition maneuvering neural network characterized by texture investigation. The author maneuvered GLCM features for the extrication of features and neural network for categorization. The thorough accomplishment of procedure was calculated concerning 80% of accuracy, 71% of SE and 87.5% of SP.

Catarina barata et al.,[43] contrasted two different approaches for the observation of skin cancer in dermoscopy portrayals depending upon local and global features. Additional objective incorporated with paper is consideration of the enact by color and texture features. The paper concluded that color features accomplished better than texture features exclusively with sensitivity of 93%and specificity of 85% and the outstanding global system outcomes were attained when abrasion area was cleaved into two sub ranges, instigating the sensitivity of 96% and specificity of 80%. Nonetheless local system accomplished preferable results concerning categorization with sensitivity of 100% and specificity of 75%

**Skin cancer detection using color features:**

Nikos petrellis [44] presented categorization of skin chaos maneuvering color signatures. The paper suggested an image processing methodology that can be enacted as a smart phone application and makes allowance for the size and color features of abrasion. Catarina barata et al. [45] presented a paper to boost dermoscopy portrayal categorization maneuvering color constancy. The author scrutinized four color constancy algorithms. The color constancy enhanced the categorization of multi source portrayals, intensifying the sensitivity of bag-of-features system from 71% to 79.7% and specificity from 55.2% to 76%. Omar abuzaghleh et al., [46] presented a computerized skin abrasion examination based on color and shape geometry feature sets. The approach contrasted two varieties of classifiers. The normal, atypical and melanoma portrayals were systematized with accuracies of 90.3%

**Literature review:**

Numerous analysts have been on the track of computer vision perspective for skin cancer recognition. Considerable methodologies for skin cancer recognition have been propounded. That one may enhance the diagnostic pursuance of skin cancer the dermatology modus operandi was flourished. Comprehensive effort has been succeeded in segregating skin abrasions amidst dermoscopy portrayals. As of now analysts have emerged diverse computer algorithms for instance clustering, thresholding, region merging and splitting, active contour models etc. Palak mehta et al.[35] presented an evaluation on approaches and steps of computer aided skin cancer recognition. The author carried out that AFINN i.e., adaptive fuzzy inference neural network administered precise outcomes than NN and fuzzy rule based methodology.

Pratic Dubal et al., [36] presented a methodology that discovered and distinguished skin abrasion as benign and malignant through the medium of neural networking. The author computed the thorough accuracy of 76.9% on accounts of asymmetry, border, color and diameter. Supriya Joseph et al.,[37] presented an impressive hair segregation methodology for segregating skin abrasion region into benign and malignant form. The author computed thorough accuracy of 91.5% and 93.5% for the second classifier.

Shivangi jain et al.,[38] presented a CAD system for skin cancer recognition maneuvering image processing appliances. The paper carried out the outcomes to be more appropriate for rural regions wherein professionals in pharmaceuticals department might not be accessible.

Azadeh noori hoshyar et al.,[39] presented the pre-refining approach considering automated skin cancer recognition approach. The entire undertaking has been segregated into image amplification and restoration.

Navneet singh et al., [40] presented a review of miscellaneous image processing methodologies that are maneuvered for diagnosis of skin ailments. The crucial objective of the paper was to
92.1% and 90.6% with 1-level classifier. With 2-level classifier the accuracies of 90.6%, 91.3% and 97.7% were computed.

**Skin cancer detection using ABCD segmentation:** Nurulhuda Firdaus Mohd [47] presented the examination of automated segregation called ABCD rule in image segmentation. The interpretation exhibit that ABCD segmentation rule outstandingly allocated the portrayals with high value of total dermoscopy score, TDS. M.Monisha3[48] classified the malignant and benign form of skin cancer by maneuvering back propagation neural network and ABCD rule. The approach computed the thorough accuracy of 95% and sensitivity of 90%.

**Skin cancer detection using fusion of features:** Faouzi Adjed et al.[49] presented an amalgamation of statistical and textural features. The statistical features were extricated from wavelet and curvelet transform wherein textural ones were extricated from differing variants of local binary pattern operators. For statistical features, the wavelet coefficients revealed better pursuance in contrast to curvelet coefficients with thorough accuracy of 85.5% and 79.85%. the amalgamation of wavelet and LBP[52]propounded best outcomes with sensitivity value of 78.93%, specificity value of 93.25% and accuracy of 86.07%. Also the outcomes were validated maneuvering SVM classifier.

**Classification using SVM:** Hiam Alquran et al., [50] presented an image processing based approach to diagnose, extricate and categorize the abrasion from dermoscopic portrayals. The author maneuvered segregation maneuvering thresholding and the features were extricated maneuvering GLCM. The features were selected maneuvering principle component analysis. The author maneuvered SVM classifier for categorization and attained the accuracy of 92.1%.

Teck Yan Tan et al.,[51] presented an intelligent decision support system for the recognition of malignant and non-malignant skin abrasions from portrayals. The portrayals were segregated maneuvering pixel limitation methodologies and features were extricated maneuvering ABCD rule and the epiluminescence microscopy criteria. The author maneuvered SVM classifier and attained the accuracy of 92%. Genetic algorithm has also been employed in order to improve the accuracy.

<table>
<thead>
<tr>
<th>Database</th>
<th>Pre-processing criteria</th>
<th>Features extracted</th>
<th>Classifiers used</th>
<th>Segmentation techniques used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermweb dataset[5]</td>
<td>Median Filtering</td>
<td>Color and textural features</td>
<td>SVM classifier</td>
<td>k-means clustering</td>
</tr>
<tr>
<td>Internet source[9]</td>
<td>RGB to Grey conversion</td>
<td>GLCM Features</td>
<td>MLP (multilayer perception) classifier</td>
<td>No segmentation involved</td>
</tr>
<tr>
<td>Dermquest and Dermis datasets[12]</td>
<td>RGB to Grey conversion</td>
<td>Geometric Features</td>
<td>KNN classifier</td>
<td>Thresholding and ABCD</td>
</tr>
<tr>
<td>Internet source[13]</td>
<td>Morphological closing and Median Filtering</td>
<td>Color features</td>
<td>Color space</td>
<td>2-D Otsu's Thresholding</td>
</tr>
<tr>
<td>UCI dataset[14]</td>
<td>Sharpening filter, median filter, smooth filter, binary mask, RGB extraction, sobel operator.</td>
<td>Color histogram; presence or absence of bumps, patches, nail beds in the afflicted skin images.</td>
<td>Decision Tree, NN, KNN</td>
<td>Otsu’s thresholding, GVF</td>
</tr>
<tr>
<td>DSSA[15]</td>
<td>Dullrazor</td>
<td>Textural features</td>
<td>MLP classifier</td>
<td>Region Growing</td>
</tr>
<tr>
<td>Department of Dermatology[17]</td>
<td>Median filtering</td>
<td>Color, textural features</td>
<td>BPNN and SVM</td>
<td>Thresholding</td>
</tr>
<tr>
<td>PH² dataset[19]</td>
<td>Artifacts removal</td>
<td>Statistical means and standard deviation features</td>
<td>ANN classifier</td>
<td></td>
</tr>
<tr>
<td>Camera images[22]</td>
<td>RGB to Grey</td>
<td>Textural features</td>
<td>SVM</td>
<td>ISODATA, Fuzzy c-means and Active contour</td>
</tr>
</tbody>
</table>
Table 1 specifies the various datasets involved for acquiring the images for skin cancer diagnosis. Also the table presents the pre-processing methodologies involved in various researches for accurate detection. The features extracted, classifiers used and the segmentation techniques maneuvered for the accurate diagnosis and to improve the performance of skin cancer detection has been proffered in the above table.

**Conclusion:** This paper scrutinized various tactics for the categorization and diagnosis of skin cancer. For premature diagnosis the paper reflected five ruling steps for computerized diagnosis of skin cancer. Miscellaneous methodologies that are beneficial in recognition of skin cancer have been implicated. The paper revealed that true diagnosis reduces the risk. In this research we have investigated various techniques and algorithms in use for prematurely diagnosing the skin cancer. This paper aims to highlight the various enhancements that have already been performed and the importance of CAD system in early diagnosis of the skin cancer. By reviewing various papers we can formulate some objectives:

- The feasibility of advocating novel refined algorithms and to bring into play the existing segregation algorithms.
- Analysis of aforementioned features and to commence innovative features through which the pursuance might conceivably be ameliorated.
- Administering prominent feature selection and/or feature reduction algorithms.

**References:**


33. N. C. F. Codella et al., “SKIN LESION ANALYSIS TOWARD MELANOMA DETECTION: A CHALLENGE AT THE 2017 INTERNATIONAL SYMPOSIUM ON BIOMEDICAL IMAGING (ISBI), HOSTED