An Empirical Study on Image Segmentation Techniques for Detection of Skin Cancer

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Authors' contributions

This work was carried out in collaboration among all authors. Author MK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ASA and VSK managed the analyses of the study. Author SAS managed the literature searches. All authors read and approved the final manuscript.

Article Information

Review Article

ABSTRACT

Skin cancer is a crucial predicament in most of western countries including Europe, Australia and America. It is quite often curable whenever perceived and treated early. The significant hazard factors related are skin shading, deficiency of sun-lights, atmosphere, age, and hereditary. The most ideal approach to distinguish melanoma is to perceive another spot in the skin or recognize that is fluctuating in size, shape and shading. Early detection of skin malignancy can stay away from death. Finding of the skin ailment relies upon the extraction of the anomalous skin locale. Right now, methods to separate the skin injury districts are proposed and their outcomes are looked at dependent on the measurable and surface properties. In this study, the myriad kind of features of Dermoscopy image analysis has been thoroughly explores. Moreover, disparity segmentation techniques for detecting Melanoma Skin Cancer are discussed. The ultimate aim of this discussion is to provide suggestions for carrying a future research based about this relevance and limitations.

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1. INTRODUCTION

A disease is a specific uncharacteristic condition that contrarily affects edifice or function of part or the entirely of an organism and that isn't because of any immediate external wound. For humans, infection is regularly utilized all the more comprehensively to allude to any condition that causes torment, social issues, distress etc. Diseases can affect physically as well as mentally, as diminishing and living with a disease can change the influenced individual's point of view on life. Nowadays, Cancer is taking into consideration as a paramount reason [1] of mortality as well as transience of human life. It is an intricate sickness instigated principally by genetic variability and a gathering of molecular revamps. Skin malignant growth [2] is one of the sicknesses that influence people. It is brought about by the advancement of malignant cells on any of the layers of skin and happens when cells in a body part start to develop wild and spread to different organs and tissues. The body continually makes new cells to enable us to develop, supplant destroyed tissue and mend wounds. Ordinarily, cells reproduce and expire in a systematic manner. A now and again cell doesn't enlarge partition and pass on in the standard way. This possibly will cause blood and lymph liquid in the body to get strange, or structure a protuberance called a tumor. It can be amiable or harmful. The primary cancer that initially creates either in a tissue or organ, has not spread to further body is called localize cancer. A tumor may perhaps assault auxiliary into surrounding tissue in addition to be capable of build up its dreadfully own veins (angiogenesis). On the other hand, those dangerous cells develop and structure another tumor at another site, it is known as a secondary cancer or metastasis. Since, skin is the biggest body part, it is taking care of numerous responsibilities including ensuring the body, managing temperature and controlling liquid misfortune. Skin, similar to all other body tissues, is comprised of cells where the two fundamental layers are the epidermis and dermis. The three primary sorts of skin malignant growths are named as basal cell carcinoma; squamous cell carcinoma; and melanoma (initiate exclusively cells of the epidermis). The former type, lofty cells structure the inferior layer of the epidermis. They increment incessantly, and the extra seasoned cells ascend inside the epidermis and smooth out to frame squamous cells. The intermediate types are level cells that are distended resolutely mutually to structure the apex and thickest layer of the epidermis. These cells are wrought from mature basal cells and they incessantly hut as fresh cells are made. The last type, cell constructs a tedious gloominess entitled melanin, the material that provides skin its gloominess Melanocytes construct supplementary melanin to safeguard it from getting scorched, when skin is obtainable [3] to the Sun. Dermis, this layer of the skin befalls underneath of the epidermis. It contains the underlying foundations of hairs (follicles), sweat organs, blood and lymph pots, and nerves, which are apprehended set up by collagen, a protein that invigorates skin its versatility and potency. Skin disease spreads by moving into the dermis by means of the storm cellar layer enabling malignant growth cells to arrive at blood or lymph vessels and move around the body.

At present, this ailment speaks to a genuine medical issue; the quest for a precise clinical finding has been a consistent worry for dermatologists. Nowadays, the deadliest kind of cancers is hard to distinct because both are resembles alike in look at the preliminary stages. Just a specialist dermatologist can distinguish these in early stage. Cells are reserved to one region and not ready to extend to further parts of the body is called as Benign tumor. The cancerous cells, that be capable of spread by going through the circulation system or lymphatic framework is named as malignant tumor. If melanoma can be detected early, it can cure completely. Currently, a few strategies on the territory of picture preparing have been create utilizing calculations or systems for identification and characterization by methods for procedures and computational techniques, which have been applied in taking care of therapeutic issues. These techniques can be a viable instrument particularly where there are not experts, on other hand it is additionally a noninvasive device for the patient. Throughout the most recent decades image processing has been applied in various territories, permit ting to improve the data on a picture for its understanding, portrayal, depiction, and preparing.

2. IMAGE PROCESSING

It is performing an amazing work in diagnostic process by means of examine in MATLAB. Besides, it can be used for early diagnosis of any diseases in myriad medical applications. Detecting the cancer in initial stage and remedy is significant. Despite being melanoma is t extensively hazardous somewhat skin cancer; it can cure in early stage [4]. Recently, a few examinations and work relate with pictures of pigmented skin sores for conclusion and arranging skin injury, for example, skin disease have been created by methods for advanced image analysis. Their primary goals have been to give a precise analysis. Most examinations are identified with the analysis of threatening melanoma. Feature extraction and segmentation methods help to find the stage of cancer. Image segmentation act as vital role in image processing for solve myriad complicated issues, specifically those associate to chronic diseases, namely skin cancer. Generally, there are three phases for analysis of automatic dermoscopy image: specifically feature selection and extraction, image segmentation, and feature classification [5].

Skin cancer is a significant health problem influencing a tremendous part of the populace irrespective of skin colors. This affectedness could be identified with dermoscopy to conclude the obvious spots are dangerous or not. Systems aid the detection process to find out the occurrence of cancer by construing medical constraints, depending upon an exact method [6] to extricate pertinent features. The outstanding techniques are to analysis lesion based on Asymmetry, Border, Color and Differential structures that name das ABCD. The classification of a tumor is carried out when clinically- relevant features are extricated. On the other hand, lopsided and scatter lesion boundaries, low contrast, noise / artifacts in images, and the presence of diverse hues within the region of interest obscure the processing of images. The abnormal (Melanoma) moles are distinguished from normal by applying ABCD rule. A doctor ought to be verified that the moles that ensure whichever of the subsequent traits.

3. IMAGE PRE-PROCESSING

It is an obligatory advance to manage image that doesn't have adequate eminence to be examined. This absence of quality occur because of the artifacts namely hair, that can contrarily impact the recital of the succeeding steps. i) Color normalization is one more significant issue. Dermoscopy images may be captured using various gadgets [7] and lighting condition, rendering un-trust worthy color information. Thusly, it might be imperative to incorporate a color improvement steps. ii) Lesion segregation is a perplexing chore that has been completely analyzed in reviews. The incredible assortment of shape, sizes and color as well as various kinds and texture make it hard to build up a vigorous segregation procedure. To accomplish an appropriate feature extraction and lesion characterization, a precise segmentation is required. iii) A vital step to attain a discriminative depiction of the skin lesion is Feature extraction. Myriad research has been achieved by finding the appropriate topographies of lesion where it can be isolated into four classes: a) hand-crafted, b) dictionary-based, c) deep learning, d) clinically inspired features. iv) To diminish the dimensionality of the feature space in certain computer-aided systems by eradicating in appropriate feature. v) Classification of Lesion – A classification algorithm [8] is accomplished to predict a diagnosis. For diagnosis processes there are myriad classifiers have been performed.

Recently, myriad hospitals and medical specialty clinics are using the computer based identification systems for detection of either carcinoma or melanoma. Image segmentation is vital task in analyzing dermoscopy image, since the skin lesion border extraction provides significant signs for precise designation. Key benefit of this computer based analysis is that patient doesn't necessity to take any excruciating diagnosing techniques like Biopsy in clinics. In this computer aided analysis, skin cancer dermoscopy image is given and it is exposed to numerous pre-processing and image enhancement. In segmentation, the cancer affected region is distinguished from the healthy skin. So as to diminish the classification complexity, specific exclusive features of malignant and benign melanoma are extracted. The following table (Table 1) depicts the various segmentation techniques to detect melanoma in skin lesion image. Moreover, performance of these methods and author details with publication year are included.

Table 1. Technique for segmentation and detection of melanoma in skin lesion image

S.No	Authors	Year	Techniques	Performance
1	Sudhriti S et al. [9]	2020	Ant colony Optimization for edge detection and global thresholding segmentation and edge smoothing operations	Significant enhancement acquired by ACO- Canny edge detection
2	Hyunju Lee and Kiwoon Kwon [10]	2020	U-Otsu method was replaced for edge-imfill method	An advance outcome obtained by associating the synchro rate w.r.t the specialist's segmentation.
3	Afsah Saleem et al. [11]	2019	Lesion segmentation has performed with a hybrid model that forms texture segregates of the illumination improved image employing a factorization technique.	This system is evaluated qualitatively and quantitatively. The segmentation and classification results of dermoscopic image dataset yield best results.
4	Halil Murat Unver and Ened Ayan [12]	2019	Merging the deep convolutional neural networks specifically YOLO and GrabCut algorithm, the skin lesion segmentation has performed in dermoscopic images.	Produce higher resolution and dimension liberated segregation outcomes thru the amalgamation of any methods.
5	Lin Huang et al. [13]	2019	Object scale-oriented is used for training whereas for fine-tuning training fully convolutional networks were functional.	This strategy is unpretentious and attained acceptable outcomes.
6	Tiejun Y et al. [40]	2019	Sampling with level set by integrating colour and texture	Indicating that it produces finest outcomes than other existing ones in terms of accurateness and adaptableness.
7	Meskini E et al. [14]	2018	PSO procedure is purposeful to decide the greatest coefficients in lieu of converting RGB to gray level. Otsu method accustomed to detect the initial contour. Chan and Vese active contour is employed for ending lesion border detection.	It leads to better segmentation results. Using gray scale images, less computational complexity than any one.
8	Mohanad Alijanabi et al. [15]	2018	Artificial bee colony (ABC) algorithm is suggested for melanoma detection.	Proficient sophisticated recital comparatively to the ground truth images keep up a skin cancer lesion doctor.
9	Ning Wang et al. [16]	2018	Structure based convolutional neural networks for segmentation of skin lesion image	Despite getting stable output (robustness), find a troublesome if more than one suspicious lesion spots in image.
10	Oludayo O et al. [17]	2018	A newfangled procedure namely PCDS including binary morphological exploration for segregation on dermoscopic image	PCDS procedure leans towards vigorously elimination the occurrence of air bubble, bushy hair, and low contrast than any others.

11	Adria Romero L et al. [18]	2017	Deep-learning based method to rectify the delinquent of categorizing a dermoscopic image encompassing a skin lesion as malignant or not.	Built around the VGGNet convolutional Neural Networks architecture includes uses the transmission erudition archetype.
12	Heydy Castillejos-F et al. [19]	2017	Wavelet-Fuzzy C-Meansis applied for feature extraction. The detection of structures that befall in the lesion is extracted via Grey Level Co-occurrence Matrix.	Erudition from the amalgamation of feature standards that represent either a malignant tumor or a benign lesion. MAEoC displays a better performance than single classifier.
13	Jafari MH et al. [20]	2016	CNN integrates local and global contextual statistics and outputs a label for every pixel, generating segregation mask those spectacles the lesion regions.	This method reaches an excessive accuracy and sensitivity then any state-of-the art methods.
14	Catarina Barata [21]	2015	Compared feature of early fusion with late fusion.	Capable of presenting the extracted color features, making the system and its verdicts more understandable for practitioners.
15	Faouzi Adjed et al. [22]	2015	Total Variation methods, a generality of Chan and Vese model for segmentation of melanoma.	Results are qualitatively noble and more precise for the finding of the ROI that specifics inside this region.
16	Damilola A et al. [23]	2013	Designing a model of a structure that organize past Pigmented Skin Lesion (PSL)	PSL image that acquire with the help of mobile, is given as input and specifically categorized the level of growth.
17	Nadia Smaoui [24]	2013	Feature extraction tracked by the ABCD rule for the diagnosis done the computation of the TDV score	Automatic pick-out of the seed pixel too the threshold certifies the finest outcomes and avoids overlay amongst the lesion and health skin.
18	Peyman Sabouri [25]	2013	An elementary border detection procedure using ZYNQ-7000 SoC, with VIVADO -HLS tool.	Extended 5 x 5 canny edge detection procedure executed on with this entrenched platform has enhanced recital.
19	Ferreira P.M et al. [26]	2012	A footnote tool for segregate manually.	It permits enrichment a ground truth database with the manual segregates in cooperation of pigments of skin lesions or any ROI.
20	M Emre Celebi et al. [27]	2012	Ensembles of thresholding methods are performed for detecting lesion border.	Easy to implement and tremendously fast, however it may not perform well on images with substantial amount of hair or bubbles.
21	Gerald Schaefer [28]	2011	Association the enhancement procedure with two segmentation algorithms namely Iterative segmentation and Co-operative neural networks	In cooperation techniques are proficient of given that noble segmentation, which the color enrichment step is certainly vital as validated thru evaluation with outcomes gotten as of the original images.

22	Maciel Zortea et al. [29]	2011	A reiterative fusion classification tactic, using a weighted amalgamation of predictable posteriors of a linear and quadratic classifier.	This system is simple and flexible adequate to permit testing with different classifiers.
23	Liu Jianli and Zuo Baoqi [30]	2009	Executing genetic algorithm thru optimization of weightiness and thresholds in Neural Networks.	For quantitative analysis and identification of the skin cancer, this continuous edge and contour technique has used.
24	Padmapriya N et al. [31]	2009	Integrate color and texture for the skin lesions segmentation from unaffected skin region	In cooperation the organizational pattern and the image color thru the distribution of the resulting features.

4. IMAGE SEGMENTATION

As the name proposes image segmentation [32], is to split an image into significant segments [33]. It progresses image analysis pre dominantly [34] for image interrogating and retrieval. In Digital Image processing, Segmentation [35] acts as a vital role for analysis. The lesion pigments are segregated [36] from the healthy skin has carried out through this segmentation techniques [20]. Due to the diverse varieties in skin and lesion, there is a great challenge for segmentation of Dermoscopic images. Moreover, between lesion and its adjoining there is a low contrast or smooth changeover. Myriad segmentation [37] has been proposed to over whelm these difficulties. This study has highlights on few latest segmentation techniques namely, Grab Cut, and Social group optimization. These algorithms are recently implemented successfully for segregation of skin lesion image and provide the reliable results.

4.1 Grab Cut Algorithm

It is an iterative semi-automatic image segmentation approach; that to be segregated is epitomized through a Graph. It is constructed with a least cost reduction function that generates the finest results. Moreover, its node is made up of the image pixel; besides two superfluous nodes namely sink and source are included to it. Association points of the foreground pixels and background pixels are epitomizes the source and sink node respectively. A cost function a graph is contingent upon the region and borderline details in the image. The Grab Cut routine pertains Gaussian Mixture Models (GMMs) acquiring the region details through the color information. The Grab Cut algorithm [12] is,

1. Draw manually, a rectangle of ROI that provides details about the interested area of background and foreground. The pixels in and out of this rectangle are considered as 'unknown' and 'background' respectively. The system builds a prototypical to define the unknown pixels.
2. To begin with, these pixels are observed as foreground where as remaining is back ground.
3. Using Gaussian Mixture Models, these two classes are formed by making C piece GMM mechanisms intended for dual areas.
4. Every pixel in the background as well as foreground class is assigned to their respective greatest probable Gaussian components GMM.
5. Using the sets of pixels formed in the preceding step, new GMM are accomplished.
6. A minimum cut procedure is accustomed define foreground and background pixels when n nodes graph has constructed and the weightiness values amongst the connections had defined.
7. Reiterated the steps 4-6while achieving the final segmentation.

4.2 Artificial Bee Colony Algorithm (ABC)

It is an optimization process [14] based on Swarm-based methodology that imitates the clever scrounging honey bee's activities. Honey bees crowd is named as a Swarm, which might be effectively complete obligations over a societal collaboration. This algorithm is classified into three kinds of bees namely worker bees, onlooker bees, and scout bees. The first kind is to search the food from near the resources from their memory; moreover share the acquaintance of the nourishment assets with the onlooker bees which decide on the excellent / fitness nourishment sources. The last kind bees are making out from few worker bees that discard their nourishment assets and search for crisp ones. The total Swarm in ABC algorithm is split into two halves, where the first part resides in worker bees and the remaining part reside in onlooker bees. The entire solution of the Swarm is corresponding to the quantity of honey bees either workers or on lookers.

The primary steps of ABC algorithm are as follows

1. Initialize Population
2. Reiteration
3. Keep the worker bees on their nourishment sources.
4. Keep the onlooker bees on the nourishment sources relying upon their nectar amounts.
5. Send the scout bees to the search area for find out new nourishment sources.
6. Memorize the finest nourishment source found up until now.
7. Until the results converge.

4.3 Social Group Optimization

There are myriad social characteristics for example, honesty, caring, sympathy, goodness, courage, tolerance and so on, deceitful lethargic in people that should be saddled and channelized the suitable way to empower him to tackle complex tasks in life. Hardly some people may have obligatory level of all these social qualities to be fit for explaining, adequately and proficiently, complex issues in life. However, the complex issues could be cracked with the impact of qualities from others (or group) in the society. Assemblage resolving ability has arisen to be added efficacy than singular ability to take care of a given issue. In view of this concept, another optimization system is proposed [38] and titled as Social Group Optimization (SGO), a population based soft computing algorithm. In SGO, the populace is considering as a group of pupil, every one obtain experiences so that having volume for rectifying a problematic, which is equivalent to the 'fitness', the best solution/ person. The best one stabs to share knowledge among all people, thus progress the level of knowledge for the whole people in the group. This algorithm [39] incorporates two primary advances, in particular (i) enlightening step that harmonizes the place of agents/people with the objective function, and (ii) obtaining stage which permits the agents to determine the finest probable result for the issue beneath anxiety.

5. CONCLUSION

Research in dermoscopic images has been expanded impressively for the early find-out of dangerous skin cancer that has reduces the death rate. Since this skin lesion is in irregular shape, it is complicated for processing till now. Feature extraction is one of the most imperative phases for analysis of it. This study assesses myriad segmentation techniques used for trailing the skin cancer lesions boundary. The results of the study depicts in table form. Myriad approaches for segregation and skin lesion detection are depicted. The result of each algorithm is greatly influenced by type of images used for analysis. Despite having advantage, each existing method shaving certain disadvantage. Among the above-said methods, the GrabCut method and ABC method provide the finest results. Mostly, the hybrid methods provided reliable results than any sole algorithm. This study will provide a significant guidance for researchers to enlarge development in their field.

In upcoming days, new model will be developed with more reliable, user friendly and more robust.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/64030