

Enhanced Diagnostic Methods for Identifying Anomalies in Imaging of Skin Lesions

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ABSTRACT- There are several types of skin diseases, to protect and keep them healthy from these ailments; an effective and efficient diagnosis is required. One of the domains used by medical experts to diagnose severe class of skin disease is medical imaging. It is non-invasive way of diagnosis in which screen of the abnormal region performs first and then the dermatologist examines the subcutaneous structure and forecasts the severity of the lesion. One severe class of lesions is skin cancer, which is categorized as melanoma and non-melanoma. Most of the research has been performed on melanoma as yet and non-melanoma cancer diagnosis is still an untouched area. The cure rate of skin cancer is high, when diagnosed at an earlier stage. The proposed approach is applicable to gray scale or single channel images and the resultant output is binary images, and this can be compared easily with the available mask in the benchmark dataset. In addition to this, the APCNN proposal minimizes the requirement of post processing step for lesion boundary detection.

Keywords: Skin cancer, Boundary, Classification, Segmentation, Invasive and Medical Diagnosis.

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1. INTRODUCTION

The largest organ in the body, the skin, is immediately exposed to the environment, making it susceptible to diseases, which are among the most well-known conditions affecting people. These ailments can abruptly grow as compared to surrounding skin and develop a lesion. There are two categories of skin lesion which exist in the human body as primary and secondary. Primary skin lesions are present at birth or developed over a person's lifespan whereas secondary lesions are the result of manipulation in primary lesions. As an example, itching in the mole by continuous scratching, leads to a secondary lesion [1].

There are various kinds of primary or secondary skin lesions occurring in different parts of the human body and few of them

are severe. The most severe classes of skin lesion are skin cancers. These are the most prevalent forms of cancer disease, particularly among Caucasian descendants and people with light skin. This cancer is visible on the skin and is curable when it is detected at an early stage [2].

The advent of noninvasive approaches give dramatic boost in clinical diagnostic ability and help to detect skin lesion more accurately. The global adoption of this technology promotes imaging methods for skin lesion screening. Most prevalent class of cancer in white color people is melanoma but in wheat or dark color people SCC commonly occur. According to cancer society statistics, the most prominent class of cancer is melanoma and their cases have increased 30 times in last 88 years. Out of them, more than 1 million cases of skin cancers are diagnosed in the US only [3].

It is approximated that around 9,500 individuals in the U.S. are found to have skin cancer every day. Not only in the U.S., there are other countries in the world, where the cases of skin cancers are promptly identified due to certain confluence factors such as skin type, location, lifestyle and up to some extent for gene predisposition. Since cancer death cases can be momentarily decreased if they are detected and taken care of during their early stages, it is of quite importance to empower research by developing strategies for early detection of cancer non-

invasively. Cancer is preventable, but requires regular screening if there is any symptom of irregular nevi. Before that, it requires to spot the abnormal growth of cells and approximate the abnormal region in a class of skin lesion. Skin lesion diagnosis requires regular screening to identify the newly-appearing, changing and disappearing abnormalities in digital images [4].

In the examination, dreadful region is observed by a dermatologist. The accuracy of prognosis is completely dependent upon the modality of input images or method used for the diagnosis. Empirical examinations illustrate that the people having no medical guidance and no exact education about dermatology are able to group the images of skin lesion in consistent classes or sub-classes. This sign advocates that some inherent visual features which can serve as guidance in the task of classification. The machine learning approaches can be used to extract these features from the visual classes using image processing and finally establish an automated system. Following are the challenges for early detection of skin lesion: Existence of blood vessels on a stretch of skin can be easily recognized by a viewer [5].

But as long as there is variability in its pattern and the presence of “discontinuities” (e.g. visible patterns of skin and hairy region), it is difficult to detect them by computer vision approach in automated systems. An important issue for lay people are the visual system design, human perception to perceive skin lesion. The difficulties arise in identifying the multiple-color shades of each lesion. For, discriminating the color shades, human inspired visual models are adopted. This phenomenon identically happens in skin lesion images for skin lesions color pattern, and it has a lot of implications on the pigmented skin lesion screening. The aforementioned challenges of skin lesion diagnosis can be profoundly handled by noninvasive. The popular imaging techniques used by dermatologists are dermoscopy. These techniques are efficiently used by the medical experts, but not by the non-practitioners or non-medicos. To analyze these parameters in standard samples of skin lesion images, an automated image processing approaches are required. Not only the socioeconomic condition, but there are other factors such as lack of awareness, education, and/or socio-cultural conditions prevent them from having regular screening [6].

Sometime, it gives alarming results such as pre-cancerous lesions gradually become cancerous. These shortcomings cultivated the research of non-invasive prognosis of image processing methods in the domain of dermatology that can act as a supportive judgment tool and it can be used by non-experienced dermatologists. Most of the non-invasive imaging systems found in literature follows a set of sequential steps: pre-processing, approximating the lesion boundaries, feature extraction and classification of lesions (two-class or multi-class). The diagnostic systems attain improved performances in experimental conditions, but commonly extract those features that are not medically detonated (that are meant for imaging only not for physicians). Alternatively, it is feasible to develop a system that focuses on the extraction of relevant

dermatological features, which are the basis of medical diagnosis [7].

Despite their propinquity with the medical diagnosis and subsequent clinical relevance, these systems have been less investigated in the literature. Moreover, the proposed methods attempt to explore dermatological criteria and analyze the clinical information which was used to diagnose skin lesions in skin lesion images.

The initial stage of this work focuses on improving lesion border detection methods, which aid in providing pertinent characteristics. To segment the borders of numerous size lesions that are randomly positioned in the input picture, a self-learning neural network is presented. The suggested method precisely defines the borders of skin lesions while automating the lesion screening system. The clinical aspects of the skin lesions are the subject of the second stage of this research, which also suggests a method based on bag of visual words (BoVW) to categories the skin lesion picture samples as benign or malignant. With this method, a descriptor is created for each pixel of a picture of a skin lesion that specifies the fundamental architecture of the skin and its colour. By preserving the intra-class diversity among the lesion class samples, it also illustrates the resilience of the suggested strategy.

2. LITERATURE SURVEY

This section reviews certain aspects of skin lesion having medical orientation. It also provides general information about skin structure and skin abnormalities associated with dermatology, along with some more information about the diagnostic methods used by medical experts. This review not only presents the important work done and published, but also plans to provide general details and ideas on skin lesion issues and attempts to elaborate its medical viewpoints. Skin mainly consists of three primary layers as illustrated in *figures 1 and 2*. Skin is the longest organ in the human body and provides a cover around the body. It protects from heat, sunshine, injury and infection. Skin also helps to manage the warmth of the body and consists of water, fat, vitamins and minerals of various types. Skin lesions are several types of skin patch which are different from the surrounding area [8].

The incidence of cancer mortality may be drastically reduced if it is discovered and treated in its early stages, hence it is crucial to support research by creating non-invasive methods for early cancer diagnosis. Cancer may be avoided, but frequent screenings are necessary if there are any signs of abnormal nevi. Prior to that, it is necessary to identify the aberrant cell proliferation and approximation of the abnormal area in a certain type of skin lesion. To diagnose skin lesions, routine screening is necessary to spot any anomalies in digital pictures that are emerging, changing, or vanishing. There is a broad variety of skin lesions that can be categorized in a hierarchical way. Primarily, each lesion is divided according to its source. Malignant lesions such as melanoma build up from melanocytes and the skin cells responsible for the production of a protein pigment called melanin and other class of lesion originated.

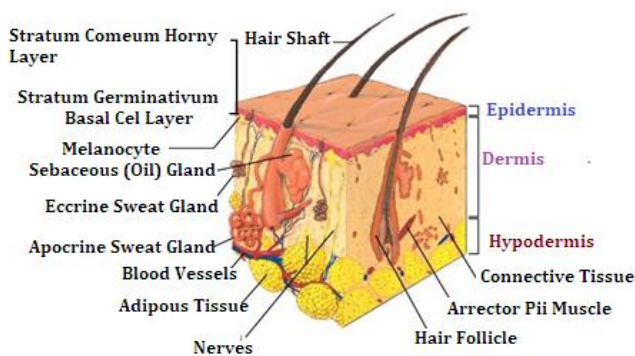


Figure 1: Layers of Human Skin

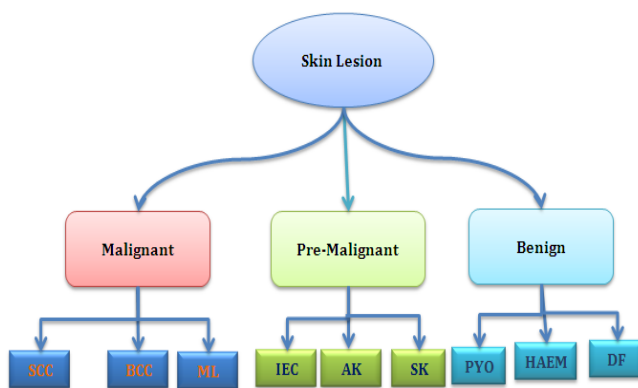


Figure 2: Skin lesion Classes

It can be divided into two groups as benign and malignant. There are various sub-groups in each group of samples. Examples, of these sub-groups or classes in standard data set are pyogenic granuloma (PYO), dermatofibroma (DF) and hemangioma (HAEM) represent benign and another sub-group of lesions or classes are melanoma (ML). Other than that, there is pre-malignant class samples of lesion which can be malignant or benign and difficult to detect, example classes are intraepithelial carcinoma (IEC), actin keratosis (AK), seborrheic keratosis (SK). In figure 2 discusses about the sample classes of skin lesion which are available in standard data set of dermoid except mole (nevi). In India, the most common type of skin cancer are SCC and BCC, due to its slow development, it is considered to be less hazardous than melanoma. The appearances of this cancer class are quite similar to one of the pre-malignant class samples (AK). AK considered to be the source class for SCC and BCC. It grows abnormally to generate a malignant class of skin lesion called as BCC and SCC. On the other side DF, HAEM and ME are vascular lumps or benign forms of skin disorder [9].

Moreover, out of the three cancers, Melanoma is the most severe type and causes majority of deaths related to skin-disease, although it is one of the most common skin cancers. On the other hand, BCCs and SCCs are less severe but difficult to diagnose as compared to melanoma. Both of cancers (BCC and SCC) have a tendency to expand and effect nearby tissues slowly and severely. Despite the growth rate of SCCs, BCCs are slow but it is quite destructive in behavior. If they are not treated

in early stages that could cause severe damages possibly affect other organs of the human body. It is not feasible to simply separate the classes based on the property of skin lesion as color and shape. There are several reasons, including the variation shown in lesion classes [10].

As an example, malignant sample class is having a sample of SCC, BCC and ML. In the next section, various standard procedure of diagnosis is going to be discuss. Although the noninvasive methods are not much accurate, but quite close to the facts. In general, dermatologist suggests treatment, according to visual information, some valid questionnaire and based on some empirical criteria of diagnosis. Although, there are few indiscernible ailments which require images of high magnification and histopathological examinations as biopsy such as cancer. There might be a mapping of skin lesion characteristics with skin lesion images, such as its structure represents the distribution of textures in image space and color variegation in different class of lesion are distributed at various wavelengths of color in medical imaging. This section summarizes the role of image processing in skin lesion screening and the standard medical procedures used to diagnose skin abnormalities [11].

It has been found that there are numerous different imaging techniques used to screen the skin lesions. The least complex perception strategy is photography and this technique gives the picture of skin upper layer. Next subsequent stage is dermoscopy techniques of polarized light camera and it helps to decrease surface impressions and illuminates the image of the epidermis – the second layer of skin. Due to this, it is easier to estimate the structures of lesions such as dots, globules, networks that are the main indicators of skin lesion diagnosis. Dermoscopy is an imaging method that gives a more straightforward connection between medical science and particular visual attributes and develop a new modality as an epiluminescence microscopy (ELM). This method has opened another way of investigating by clinical examination of morphological markers for pigmented skin lesions [12].

In addition to this, visual perception of the lesion by Ultrasound is another detail modality of diagnosis. Ultrasound imaging is generally used to quantify the profundity of skin lesion and if there are no variations from the normal skin, then there are no distinctions between the two regions. At this point when specialist analyzes lesions and utilizes high recurrence ultrasound (more than 30 MHz) to gauge infiltration profundity so as to make right cut and adopt right medical procedure. Visual review with the bare eyes has a generally low sensibility in identifying early abnormalities as a lesion. In this particular circumstance, a few non-invasive modalities of skin lesion images as dermoscopy. It is all about body photography and other one is the confocal microscopy reflectance (RCM), which are currently being developed to increase diagnostic accuracy by analysis microscopic skin structures [13].

The principle of improvement in this field is the integration for the clinical practice of dermoscopy and computerized photography. Developing advance imaging modalities creates more refined methods of prognosis. Dermatologists use certain

diagnostic criteria to distinguish between various types of lesions. Some of these criteria are related to the set of patterns and colors that are observed in the skin lesion images. The first method was proposed in 1985 by Friedman to diagnose skin lesions is called pattern analysis. This method considers a set of patterns, also called global features that can be found in each type of skin lesions [14].

A specific pattern is characterized by one or more fundamental skin structures by local features (image descriptors) that can cover parts or the entire lesion. In addition, there are a variety of diagnostic approaches such as ABCD rule, Menzies technique, 3-point and 7-point checklist to evaluate lesion structures and patterns, using non-invasive imaging system.

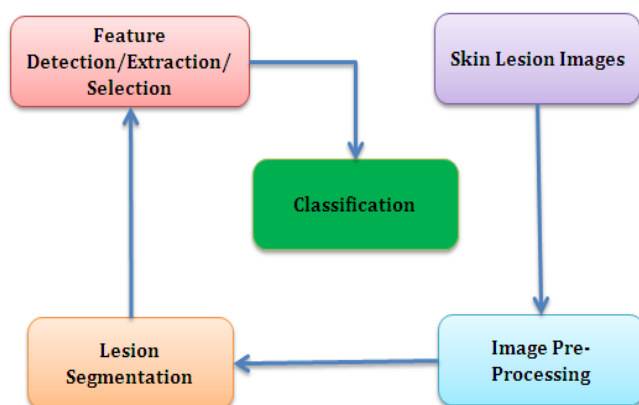


Figure 3: Homogeneous Framework

The standard diagnostic rule of skin lesion is ABCD in the domain of dermatological was suggested in 1994 by Stolz. Precisely, the following rule used to evaluate the properties of lesion as asymmetrical, border, color and, diameter. The diagnosis of abnormalities in standard skin lesions images is a challenging task [15].

Indeed, even if therapeutic calculations are used, for example, the ABCD criteria and the standard 7- point checklist rules. In every possible case it is difficult to separate lesion class or identify the severe sores of the skin and its types because the inclusion of noise, concealing structures, biological complexity and anisotropy of the imaging system render the automated analysis of dermatological images a difficult task. Due to this, it reduces the probability of detection and increases the specificity of lesion diagnosis. The past downsides inspired to use homogeneous frameworks for abnormality detection in a more precise way [16].

A computer-aided diagnostic framework (CAD) has different resources that dermatologists can use. In the first perspective, the diagnosis will not depend on the individual who uses it at any instant, so that the prognosis will be reproducible every time to detect skin lesions and improve their accuracy. As a second view, the CAD framework can be utilized by both experienced and non-experienced dermatologists. The second viewpoint for the functioning of a learning gadget use to ease

the prognosis and make revolutionary change in the field of dermatology [17].

There are several CAD systems for anomaly detection for melanoma, but very few has been proposed for non-melanoma skin lesion. One of the best approaches in the diagnosis of medical images is to solve the challenges mentioned above. Some kind of spurious information about the image structures is to be exploited out of them. Lesion boundary detection is the initial phase in the automated investigation of skin lesion images. It is essential for the following reasons: (a) The boundary structure gives significant information for accurate detection of lesions, (b) Extraction of other essential features such as various structures and colors of lesions. Lesion structure and variegated color is completely depending upon the accuracy of lesion outskirts detection. Although, the extraction of features is a vital step but finding an appropriate feature for certain application requires detailed knowledge [18].

A lot of studies have been done in this sector, identifying a wide range of dermatological features that characterize skin lesions and able to classify them accurately. The primary purpose of feature extraction is to quantify the unified signs used by the finite set of pixels for determining the malignancy of a skin lesion or categorizes the lesions class in skin lesion images. In a given image, isolation of features is an important measure for accurate classification [19].

To perform analogous activity, what dermatologists used to do for classifying the skin lesion images, it is also essential to extract features that characterizes the lesions in a computer aided framework. There are various characteristics that can be used to define skin lesions. These sorts of characteristics can be split into two distinct groups as global and local features used to perform image analysis [20].

The global image features present image as a whole while local feature symbolizes image patches. The approaches used by dermatologists and dermopathologist in diagnosis of skin lesions involves a general clinical examination and histopathological view. This diagnosis can also be done by computer aided image processing system which is considered to be a non-invasive approach. Based on the literature survey [21], it has been found that the development of efficient techniques and effective computing models for identification of skin lesion recognition from skin images needs research attention by considering the identified research gaps.

3. PROPOSED SYSTEM

An automated computer vision system can recognize most of the objects in an image similar to human observation, and able to trace and reflect the lesion boundaries correctly. This has led to the development of many different methods of image segmentation and lesion border detection. Boundary structure leads to important information for accurate prognosis of the skin lesion and help to extract the clinical features from it. In boundary detection assignment and pattern recognition, neural networks have been effectively used [22]. However, there is a great necessity to analyze the various types of neural network

and identify the correct model to apply. Although, there are various methods for lesion boundary detection which has to be categorized into manual, semi-automated and automated methods. Based on requirements, selection of lesion border approximation method is performed and it considered to be an essential measure for the development of new diagnostic framework [23].

The easiest and most common approach of segmentation is the gray-level threshold, but the suitable threshold is very hard to select. In this paper, one of the thresholding approach used to segment the lesion border is a pulse coupled neural network. The APCNN approaches automates the way of segmentation by considering exponential entropy as an activation function. It motivated us to think about the method which follows the same kind of distribution adopted by auto-waves pulses in image space and helps to segment the ROI from images. The behaviour of APCNN is quite similar to visual cortex [24].

The APCNN consists of two chambers as feeding and linking to fed input responses of images in parallel and last chamber know as internal activation decides the threshold function of image pixels. The complete system describes the processing unit as similar to the structure of visual cortex, in which dorsal and ventral streaming work in parallel. Interest in computer-aided skin disease diagnostics has increased significantly over the past century due to the advances in skin imaging technology and expansion of advanced imaging methods.

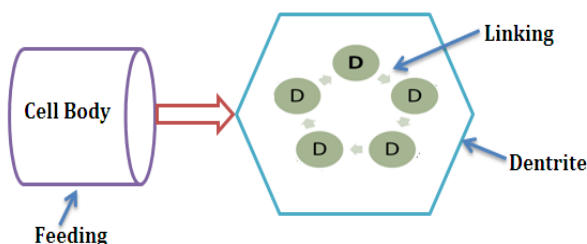


Figure 4: Representation of biological model

The primary step of a CAD system is automated detection of lesion boundaries and it considered to be an essential because of the two reasons. Although the skin lesion images are quite large and lesions acquire very small area, to approximate the accurate boundaries and evaluate the exact size of the lesions, there is need of automated image segmentation [25].

This work presents an approach used to detect lesion boundaries in sequential steps of preprocessing, segmentation and post-processing steps [26].

The suggested techniques are resilient and efficient, so they can be simply handled the vast variation of picture samples in the input space. They are also able to analyse standard camera images that can be conveniently provided for diagnosis. The PCNN is local thresholding approach, commonly used for complex images for lesion border detection. While these approaches are flexible and can adapt thresholds, but there are still some drawbacks during image segmentation, such as it is time consuming and not able to delineate the accurate

boundaries of the lesion. The Pulse Coupled Neural Network (PCNN) model is represented in *figure 4*. Sometimes the PCNN is also referred as a cortex modeled on a computer [27].

The visual cortex is the component of the brain and it gets data from the eye. Eye sends to the cortex a processed image and cortex return the image as a pulses string. It specializes in the processing of stationary and moving objects of the input data, performs object boundaries detection and pattern recognition task. PCNNs are used mainly in image processing and give decision about an image's content. There are biological models which help to generate various replica of PCNN. Because of its distinct morphology, the cell body has a dendrite neuron and its structure can be modified from the existing form as illustrated in *figure 4*. In a pulse-coupled neuron there are three compartments: feeding, linking and pulse generator. It is a two-dimensional neuronal array, typically with a single layer [28].

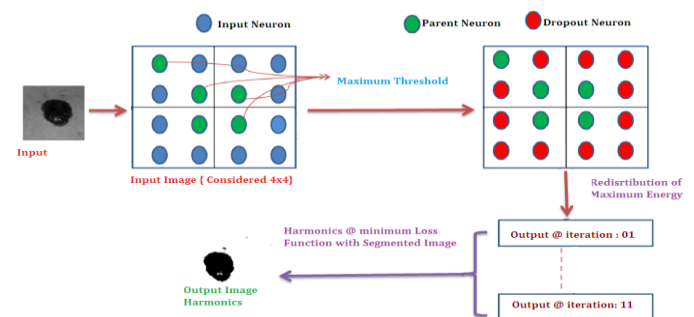


Figure 5: Internal Architecture of PCNN

The feeding and linking synapses are connected in their dendrite structure and electric pulses at the synapses are more than threshold, then neurons fire and activity is performed. The given task is skin lesion boundary detection in which proposed model responded to the external stimuli in a iterative manner. The repetitive framework employed in PCNN defines a modulation task and assigns the time period for each image harmonic by calculating the time difference between the two image occurrences. The number of images as an output is obtained at certain threshold is within the limit of [0, 1] and generates PCNN time series. In PCNN, the action is performed with respect to pixel intensity. The image data of skin lesion images are captured from charge coupled device (CCD) camera at certain energy. Energy is a square of intensity and it represents high signal strength among the adjoining neurons of an image [29].

The proposed approach considers the exponential entropy as a pulse source instead of energy among the adjoining neurons of an image. In the proposed network, exponential entropy decides the threshold for firing neurons. It identifies that the threshold at which firing of neuron performed is having the maximum energy as well as maximum information carrier as an entropy [30].

The fired neurons are known as parent neurons. Instead of pulsating at every neuron, the proposed network selects the parent neuron and performs actions on it. These two factors help to manage the noise level during segmentation and reduces the

computation time of existing PCNN. The internal architecture of PCNN is shown in *figure 5*. It clearly specifies the simplicity of the dense network in the image space by considering the parent neuron and minimizing the number of harmonics.

4. DATA SET

The lesions of all ten classes are mainly categories cancerous or non-cancerous. The non-cancerous class also includes precancerous and tumor classes. The melanoma, keratosis and carcinoma classes are considered to be cancerous and remaining all the class samples are considered to be non-cancerous. The results related to one class of lesions called as pyogenic granuloma is illustrated in *figure 6*. It shows that obtained threshold for parent neurons generates minimum number of harmonic images. In this process, a fundamental concept of PCNN is considered, which represents that the size of PCNN structure is equal to size of input image. Initially, the input image (100x100) is convoluted with mask (15x15) and it divide them into four quadrant and able to select the most efficient harmonic (images in which complete boundary of lesion detected) among all the obtained responses during each of the quadrant.

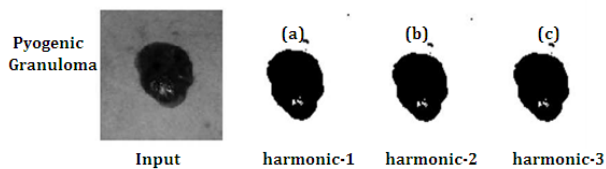


Figure 6: PCNN harmonics of pyogenic granuloma lesion class

As we discussed pulsation is not going to be analyzed for every pixels of the image in the APCNN. The proposed network considered to be low density network because of the large number of dropout neurons as compared to standard PCNN network. The proposed approach is suitable for different size of randomly located lesions in skin lesion image. One important issue to be highlighted here is that as lesions are centrally located in standard images, so the APCNN approach gives more accurate results. APCNN is computationally efficient and robust. A comparison is drawn of the proposed approach with the existing approaches: Pulse couple neural network (PCNN), Active snake (AS), Adaptive threshold (AT), on the basis of the following measure which helps to validate the output image obtained at specific threshold in these thresholding approaches.

5. RESULTS AND DISCUSSION

The acquired findings are shown in *figures 7 and 8* and aids in defining the distinct borders of lesions. *Figure 9* is a representation of the obtained results. It is found that the computational time also decreases to 1/10 as compared to the time taken by the standard PCNN. It also illustrates that the iteration number on which best two of the harmonics are generated as shown in APCNN (IN), such as AK generates the output at 11 and 69 iteration number.

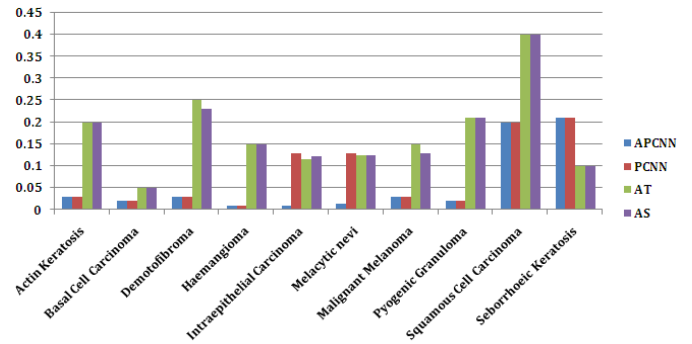


Figure 7: Hammond distance comparison for boundary detection of skin lesion classes

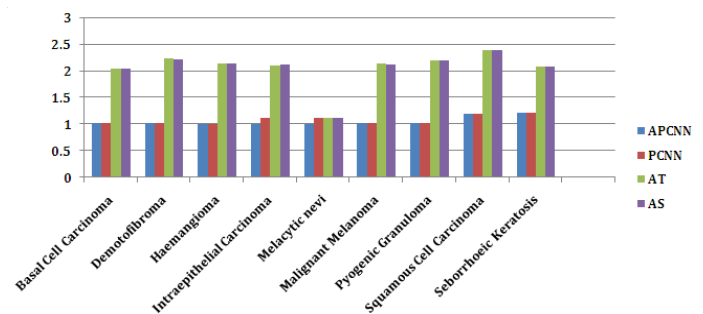


Figure 8: Gray level contrast comparison for boundary detection of skin lesion classes

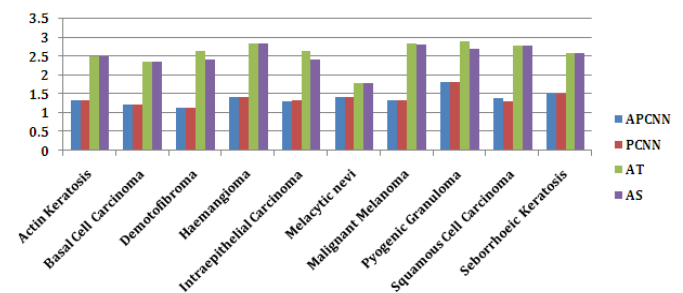


Figure 9: Overall accuracy comparison for boundary detection of skin lesion classes

This approach has an internal activation function based on exponential entropy which helps to calculate the lesion information stored in the matrix of an image. The co-occurrence matrix having a covariance in the range of [0 1] for energy and entropy which is used to detect the lesion patterns by removing the redundancy of feature vector. The considered features are subjective in nature and obtain effective threshold which liable to discriminate the samples into two classes. To skin lesion detection, 24 samples are randomly selected from each class of standard dataset. In the next section, a comparison is drawn between APCNN and other thresholding methods which are optimized with the threshold in the same way as of proposed approach. After optimization, these approaches are accelerated by GPU.

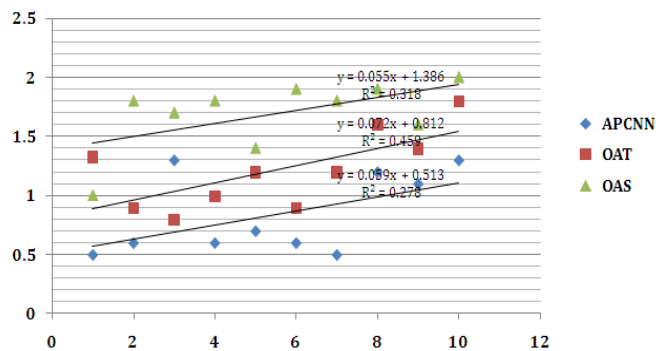


Figure 10: Linear Regression APCNN, OAT and OAS

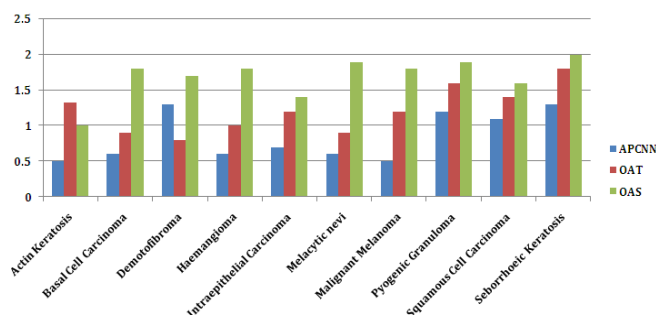


Figure 11: Comparisons of computation time on GPU

The results shown in *figure 10* and *figure 11* reveal that the performance of APCNN as compared to two other approaches, is still outperforming for the classes of pre-cancer (AK, IEC). However, the comparison of computation time is also illustrated in the *figure 11* and it shows that the computation time is independent of skin lesion class discrimination. Results depicted that the computation time entirely depends on the property of structural region's compactness. It is available in more compact skin lesion groups like HAEM, IEC, PYO, AK, BCC and consume less time than the time taken by scattering lesion pattern of DF, MEL, SCC, SK class. Observation is primarily used to diagnose common skin diseases. Medical experts make the diagnosis by standard diagnostic procedure and provide treatment based on visual information and standard diagnostic rules. There are few indistinguishable diseases requiring pattern analysis and histopathology analysis. The processing of global features of the lesion may be missed and relevant clues are encouraged to go locally. This work uses descriptor for color and spectral features to describe the lesion and apply the bag-of-visual-words (BoVW) technique to handle this problem. It also classifies the samples as malignant or benign. With this method, the automatic analysis of lesion can be used, exactly what the dermatologist does, in the sense that it also searches for relevant localized aspects. In complex image analysis, several problems such as scene recognition and object identification, features extraction have been used successfully. In the context of malignancy detection, however, they were rarely explored.

Only six of the ten classes in the standard picture collection are taken into account in this study and organised into groups as seen in *figure 12* and *figure 13*. The remaining class samples are

pre-malignant such as Actinic Keratosis (AK), Intraepithelial Carcinoma (IEC) and Seborrheic Keratosis (SK). It requires a common scale of diagnosis known as the degree of malignancy is used to recognize the lesion as malignant.

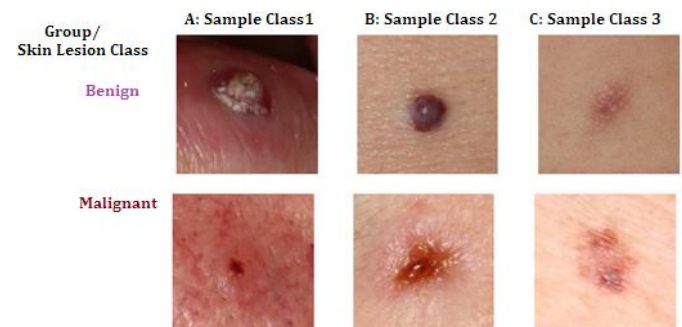


Figure 12: Skin lesions samples are categorized

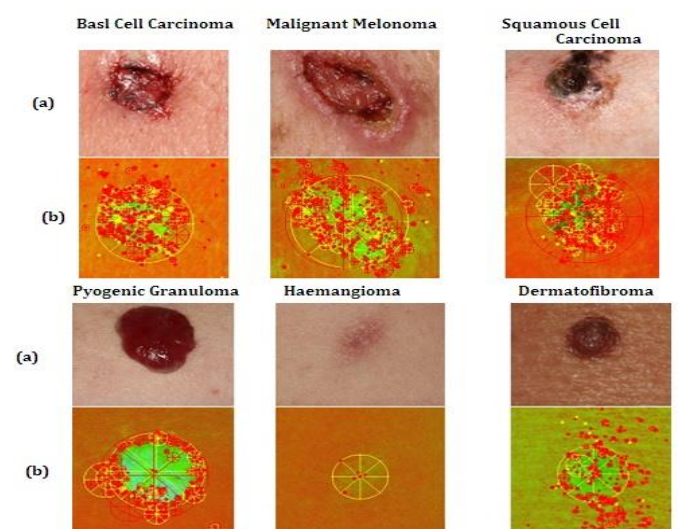


Figure 13: (a) Input Images (b) Output Images using IHID descriptor

The overall count of lesion samples from 6 different classes is 144 out of 826. These pre-malignant classes require more clinical measures for the computation, so we remove these data samples from the input set. It shows that IHID descriptor is the finest combinations of two features bag as GLOH-HSV. The obtained result is not only good but excellent in the domain of dermatology because they manage the important measure of data class as intra-class variability. The obtained accuracy of 78%, highlights the importance of HSV color descriptors for skin lesion recognition. In order to minimize this gap between high-level representation (as interpreted by medical experts) and the low-level depiction (detected by CAD), different color and patterns of the lesion has been explored. The major challenge is to discriminate the samples of skin cancer lesions with their associated precancerous and tumor class samples. The example of connected class labels is actinic keratosis caused by UV radiation and it progresses to develop a squamous cell carcinoma. The nature of the disease depends on a variety of clinical features such as bleeding, the diameter of the disease is greater than 1 cm and rapidly growing in every direction. The irregular growth of actinic keratosis is a major cause of non-melanomic skin cancers such as squamous cell carcinoma. So,

it can be concluded that AK is a predecessor for SCC. There are various features vectors and its directional growth are used to symbolize by the bag of features for various applications of computer vision.

6. CONCLUSION

In this research work proposed an approach for lesion boundary detection in skin lesion images. There are approaches for global and local image segmentation but APCNN effectively segment the randomly located lesions of various size in single input image. The obtained threshold in the proposed approach is capable of differentiating the lesion class as cancerous or non-cancerous with an overall accuracy of 95.1%. The proposed approach is applicable to gray scale or single channel images and the resultant output is binary images, and this can be compared easily with the available mask in the benchmark dataset. In addition to this, the APCNN proposal minimizes the requirement of post processing step for lesion boundary detection. It is faster and more robust as compared to the existing approaches used for lesion border detection. GPU platform is used to manage large amount of data in automated system for skin lesion diagnosis and make them computationally efficient. Despite the assuring results for boundary detection, it was not possible to assuredly discriminate the lesion class into cancerous and non-cancerous by the proposed method. The proposed approach is incompetent to process the pigmented skin lesion images and to straightway manage these images have to proceed to the next step of feature extraction. Pre-malignant class of samples may be taken into account for a skin lesion detection system in the future when a more in-depth description of skin pictures is needed.

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