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Highly Accurate Melanoma Detection from Skin Images using Multiple Feature Extraction and Support Vector Machine (SVM)

Shiji A S, Helintha Graceline H, Abisha Jey J B

***Abstract**:-- Digital image processing (DIP) plays a major role in the biomedical image segmentation and classification process. Melanoma detection from skin images is most widely using the application in biomedical imaging. In this paper, a novel algorithm for Melanoma Detection from digital images using multiple feature extraction with a Support Vector Machine (SVM) for highly accurate classification. Multiple features such as color, texture and statistical features are considered to train the SVM. To increase the classification sensitivity, feature extraction is done in (Red, Green, Blue) RGB and (Hue, Intensity, Saturation) HIS color domains. Two separate modules for training and testing is performed with collected sample data by using medical experts. To separate the region from the skin, a cantor-based segmentation technique is used in the gray level component of the input image. The proposed method is tested with various images that are collected from different patients from different places. Form the result validation it is clear that the proposed algorithm can give maximum accuracy of 95% which is best when compared to the conventional classification algorithms*

Keywords: Melanoma, RGB, HIS, Support Vector Machine, texture feature, statistical feature.

I. INTRODUCTION

Cancer is a gathering of diseases including unusual cell development with the possibility to attack or spread to different organs of the body. These appear differently in relation to kindhearted tumors, which don't spread. Possible signs and side effects incorporate a protuberance, strange dying, delayed hack, unexplained weight reduction, and an adjustment in entail movements. While these side effects may demonstrate cancer, they can likewise have other causes. Over 100 sorts of cancers influence people. Skin cancer is the strange development of skin cells. [1] Regularly creates on skin presented to the sun. Be that as it may, this regular type of cancer can likewise happen on territories of your skin not normally presented to daylight. There are three significant kinds of skin cancer basal cell carcinoma, squalors cell carcinoma, and melanoma. Skin cancer grows principally on the scalp, face, lips, ears, neck, chest, arms and hands, and on the legs in ladies. In any case, it can likewise frame on territories that infrequently come around for instance palms, underneath your fingernails or toenails, and your genital territory.

Skin cancer influences individuals of all skin tones, incorporating those with darker appearances. At the point when melanoma happens in individuals with dim skin tones, it's bound to happen in zones not typically presented to the sun, for example, the palms of the hands and bottoms of the feet. Non-melanoma skin cancer consistently reacts to the treatment and once in a while spreads to other skin tissues. Melanoma is riskier than most different sorts of skin cancer. On the off chance that it isn't recognized at the starting stage, it is rapidly attacked close by tissues and spread to different parts of the body. A formal determination strategy for skin cancer discovery is the Biopsy technique. [2] A biopsy is a technique to evacuate a bit of tissue or an example of cells from the tolerant body so it very well may be investigated in a research facility. It is an awkward strategy. Biopsy Method is tedious for tolerant too as a specialist since it requires some investment for testing. A biopsy is finished by expelling skin tissues (skin cells) and that example experiences the arrangement of research facility testing. There is the plausibility of spreading malady into another piece of the body. It is more unsafe. As the quantity of patients builds, it turns out to be increasingly hard for radiologists to finish the indicative procedure in the constrained accessible time. The inspiration for this work is to help radiologists in expanding the fast and precise discovery pace of skin cancer utilizing Deep Learning (DL)

Early determination of skin cancer is a foundation for improving results and is associated with 99% in General Endurance (GE). In any case, when skin cancer is in cutting edge stages, GE tumbles to 5%. In any case, with fitting advancement and reasonable assessment, current electronic innovation could improve demonstrative precision. Without a doubt, man-made Artificial Intelligence (AI) algorithms sorting photos of injuries have as of late been demonstrated to be equipped for ordering melanoma with a degree of ability practically identical with dermatologists.

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* Correspondence Author
Shiji.A.S *, Department of Electronics and Communication Engineering, Narayanaguru college of Engineering, Manjalumoodu, India. Email: shiji842003@gmail.com
Helintha Graceline.H, Department of Electronics and Communication Engineering, Narayanaguru college of Engineering, Manjalumoodu, India. Email: ingra_helintha@yahoo.com
Abisha Jey J B, Department of Electronics and Communication Engineering, Narayanaguru college of Engineering, Manjalumoodu India. Email: abishajey1995@gmail.com

For quite a while, the issue of characterizing skin diseases has additionally moved into the focal point of the AI people group. Robotized sore arrangement can both help doctors in their day by day clinical daily schedule and empower quick and modest access to lifesaving to analyze, even outside the medical clinic, through the establishment of applications on cell phones. [4] Prior to 2016, examine generally pursued the old-style work process of AI: pre-processing, segmentation, feature extraction, and order. Be that as it may, a significant level of utilization explicit skill is required, especially for feature extraction, and the determination of sufficient features is very tedious.

[5] Likewise, blunders and the loss of data in the principal handling steps affect the arrangement quality. For instance, a poor segmentation result regularly prompts poor outcomes in feature extraction and, thus, low grouping precision.

Considering every one of the cases referenced above, So Skin cancer recognition utilizing SVM is proposed. This procedure employments advanced picture handling method and SVM for grouping. [6] This procedure has enlivened the early identification of skin cancers and requires no oil to be applied to your skin to accomplish clear sharp pictures of your moles. Along these lines, it's speedier also, cleaner approach. Be that as it may, above all, because of its higher amplification, Skin Cancer Detection Using SVM can avoid the pointless extraction of splendidly innocuous moles and skin injuries. The rest of the paper is organized as follows: Section II reviews the related work. Section III explains the proposed segmentation model. Section IV gives a detailed analysis of the results. Section V concludes the paper

II. PRIOR WORKS

Ho Tak Lau, Adel Al-Jumaily proposed an Automatically Early Detection of Skin Cancer Study Based on Neural Network Classification, in which, an automatically skin cancer characterization framework is created and the relationship of skin cancer image crosswise over various kind of neural network are contemplated with various kinds of preprocessing. The gathered images are feed into the framework, and crosswise over various image handling strategy to improve the image properties. [7] At that point the normal skin is removed from the skin affected area and the cancer cell is left in the image. Valuable data can be separated from these images and pass to the classification system for training and testing. The recognition accuracy of the 3- layers back- propagation neural network classifier is 89.9% furthermore, the auto-associative neural network is 80.8% in the image database that incorporates dermoscopy photograph and a digital photograph

Mahmoud Elgamal proposed an automatic skin cancer images classification technique, the basic concept is similar to the previously mentioned study, the difference is which includes three stages, namely, feature extraction, dimensionality reduction, and classification. In the first stage, we have gotten the features related to images utilizing discrete wavelet transformation. In the subsequent stage, the highlights of skin images have been decreased using principal component analysis to the more essential features. In the classification stage, based on supervised machine learning have been developed. The primary classifier based on feed-forward back-propagation artificial neural network and the subsequent classifier dependent on a k-closest neighbor. [8] The classifiers have been utilized to classify subjects as normal or abnormal skin cancer images. Order with an achievement of 93% also, 93.5% has been gotten by the two proposed classifiers and respectively.

There is a proposal on Methodology for diagnosing skin cancer on images of dermatologic spots by spectral analysis was by Esperanza Guerra-Rosas and Josué Álvarez-Borrego. which depends on utilizing Fourier spectral analysis by using filters such as the classic, inverse and k-law nonlinear. [9] The sample image was acquired by a quantitative measurement and another spectral technique is created to acquire a quantitative estimation of the complex pattern found in cancerous skin spots. At long last, a spectral index is determined to get a range of spectral indices characterized by skin malignant growth. The result will appear at an accuracy level of 94.5%.

A new advanced method on Detection and Analysis of Skin Cancer from Skin Lesions was proposed by Nidhal K. [10] EL Abbadi and 2Zahraa Faisal images are filtered to remove undesirable particles, at that point another technique for programmed segmentation of lesion territory is done dependent on Markov and Laplace filter to identify lesion edge, trailed by convert picture to YUV shading space, U channel will be processed to remove thick hair and concentrate lesion region. Finding skin cancer accomplished by utilizing ABCD rules with a new strategy for deciding asymmetry dependent on the rotation of lesion and divide lesion to two sections horizontally and vertically at that point check the number of pixels confounded between the two sections based on union and intersection between the two parts. A new strategy to decide the quantity of the number of colors based on the suggestion of color regions for each color shade was suggested in this paper.

A Deep learning-based skin lesion diagnosis was proposed by D.A. Gavrilov, N.N. Shchelkunov, A.V. Melerzanov. State-of-the-art solutions in the field of image processing and machine learning allow creating intelligent systems based on artificial convolutional neural network exceeding human's rates in the field of object classification, including the case of malignant skin lesions. [11] This proposal presents an algorithm for the early melanoma diagnosis based on artificial deep convolutional neural networks. The algorithm proposed allows reaching the classification accuracy of melanoma at least 91%.

An innovative study on Automating Skin Disease Diagnosis Using Image Classification was conducted by Damilola A. Okuboyejo, Oludayo O. Olugbara, and Solomon A. [12]Odunaike. which focused on designing and modeling a system that will collate past Pigmented Skin Lesion (PSL) image results, their analysis, corresponding observations and conclusions by medical experts using prototyping methodology. The information will be used as a library. A part of the system would use computational intelligence techniques to analyze, process, and classify the image library data based on texture and possibly morphological features of the images.

Trained medical personnel in a remote location can use mobile data acquisition devices (such as cell phone) to generate images of PSL, supply\ such images as input to the proposed system, which in turns should intelligently be able to specify the malignancy (life-threatening) or benign (non-threatening) status of the imaged PSL.

Automated detection of non-melanoma skin cancer using digital images mainly based on Computer-aided diagnosis, but its application to non-melanoma skin cancer (NMSC) is relatively under-studied. The study by Arthur Marka, Joi B. Carter, Ermal Toto & Saeed Hassanpour is aiming to synthesize the research that has been conducted on automated detection of NMSC using digital images and to assess the quality of evidence for the diagnostic accuracy of these technologies.

[13] The method follows Eight databases were searched to identify diagnostic studies of NMSC using image-based machine learning models. Two reviewers independently screened eligible articles. The level of evidence of each study was evaluated using a five-tier rating system, and the applicability and risk of bias of each study were assessed using the Quality Assessment of Diagnostic Accuracy Studies tool.

III. PROPOSED SYSTEM

The proposed system has two phases namely the Training and testing phase. In the training phase, the images are undergoing several steps they are normalization, image enhancement, image segmentation, and feature extraction. Fig.1 shows the proposed system.

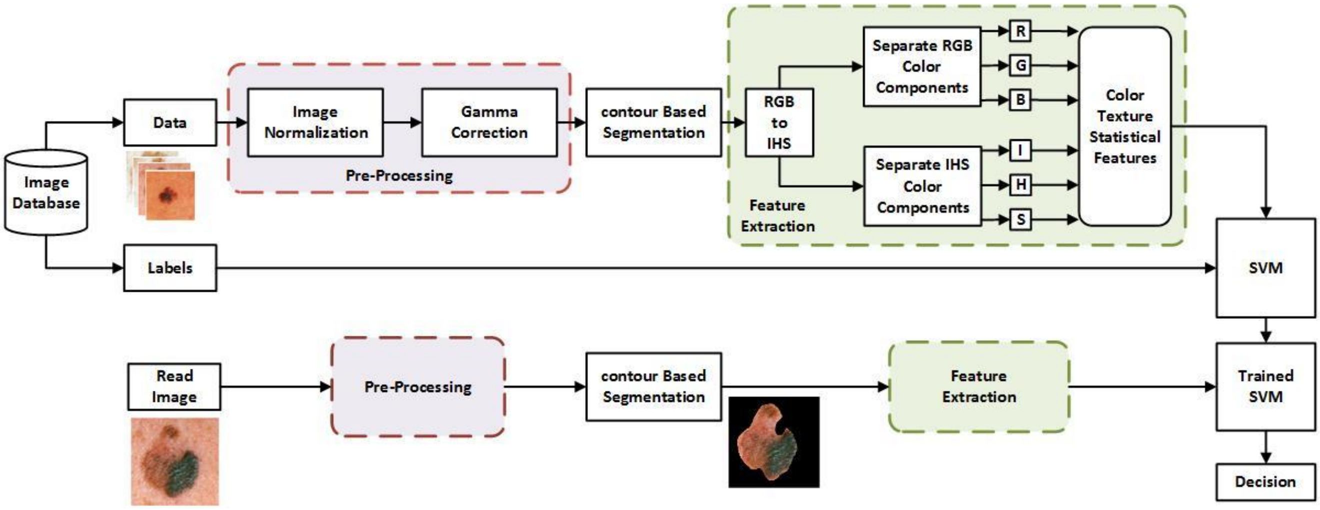

Fig.1. Block Diagram

A. *Preprocessing*

In image processing, standardization is a procedure that changes the extent of pixel intensity. Standardization is in some cases called differentiate extending or histogram extending. In increasingly broad fields of information handling, for example, computerized signal preparing, it is referred to as powerful range expansion. The motivation behind powerful range extension in the different applications is, for the most part, to bring the picture, or another kind of sign, into a range that is increasingly natural or typical to the faculties, henceforth the term standardization. Frequently, the inspiration is to accomplish consistency in a powerful range for a lot of information, flag, or pictures to stay away from mental interruption or exhaustion. [14] For instance, a paper will endeavor to make the entirety of the pictures in an issue share a comparative scope of grayscale.

Normalization convert k dimensional gray image $P:\{M \in F^i\} \rightarrow \{J, \dots . K\}$ with intensity values into a new image $P_{new}: \{M \in F^i\} \rightarrow \{J_{new} \dots \dots , K_{new}\}$.

The linear normalization of a gray image is given by the following formula.

$$P_{new} = (P - J)\frac{K_{new} - J_{new}}{K - J} \quad (1)$$

B. *Gamma Correction*

Gamma correction, or regularly basically gamma, is a nonlinear activity used to encode and interpret luminance or tristimulus values in video or still picture systems. [14] Gamma correction is, in the least complex cases, characterized by the accompanying force law articulation:

$$I_{out} = KI_{in}^{\gamma} \quad (2)$$

where the non-negative genuine info esteem I_{in} is raised to the power$\gamma$and duplicated by the consistent K, to get the yield esteem Iout. In the regular instance of K = 1, information sources and yields are commonly in the range 0–1.

C. *Contour Based Segmentation*

In an image an active contour is a curve that is allowed to change its location and shape until it best satisfies predefined conditions. In this segmentation an object is segmented by letting the object to settle like a constricting snake around the boundary of the object. A snake C is modeled as a parameterized curve C(s) = (x(s), y(s)), where the parameter s varies from 0 to 1. So, C (0) gives the starting point and C (1) indicates the end coordinates point. An energy minimization process gives the snake movement model.

$$E = \int E(C(s))\, ds \quad (3)$$
$$= \int Ei(C(s)) + Ee(C(s)) + Ec(C(s))\, ds$$

The internal forces of the snake is given by Ei,the value of the Ei changes depending upon the snake change. Ee decreases if the snake shifts closer to any portion of the image, [15] Ec gives an additional constraints, such as penalizing the creation of loops in the snake, moving too far away from the initial position, moving into an undesired image region. For most cases, Ec is set to zero. The internal terms and external terms are defined as:

$$\text{Ei} = \text{c1} \left\|\frac{dc(s)}{ds}\right\|^2 + \text{c2} \left\|\frac{dc(s)^2}{ds^2}\right\|^2 \quad (4)$$
$$= -\text{c3}\|\nabla \text{f}\|^2$$

Where the external term depends upon the attraction of snake to the edges of the taken original image f. An other external terms are used to mention the different features of the image, making ridges, find out the corner points, etc. The relative influence of each and all term constants like c1, c2, and c3 determine the snake movement. [15]Fig.2.indicates the evaluation of an object image and snake towards the given object. The given first image shows the position of the snake and the remaining images gives the evaluation of snake towards the boundary of the image.

In the last image gives the shape of the given object very perfectly and clearly.

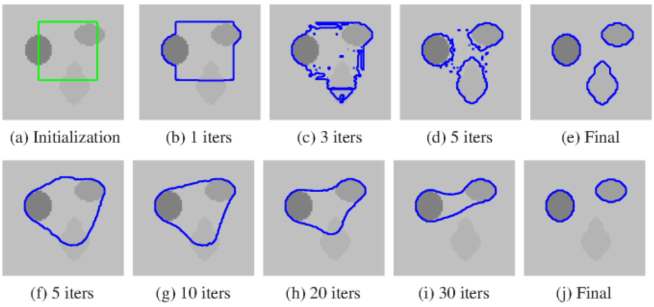

Fig.2.Contour Based Segmentation

D. *IHS Color Feature*

The Intensity-Hue-Saturation (IHS) transformation decouples the intensity information from the color carrying information. The hue attribute describes a pure color and saturation gives the degree to which pure color is diluted by white light. This transformation permits the separation of spatial information into one single intensity band. There are different models of IHS transformation. The models differ in the method used to compute the intensity value. Smith's hexacore and triangular models are two of the more widely used models. The hue and saturation values are computed based on a set of complex equations.

While converting color from RGB to IHS following transform is used.

$$\begin{bmatrix} I \\ V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 1/3 & 1/3 & 1/3 \\ -1/\sqrt{6} & -1/\sqrt{6} & 2/\sqrt{6} \\ 1/\sqrt{6} & -2/\sqrt{6} & 0 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (5)$$

$$S = \sqrt{V_1 + V_2} \quad (6)$$

$$H = \tan^{-1}\left(\frac{V_2}{V_1}\right) \quad (7)$$

The advantage of the IHS is that large volumes of data can be processed quickly and sharp images are generated. The disadvantage is that it might result in a spectral distortion from the original multispectral image.

E. *Color feature*

Color is a significant and the most straight-forward element that people see when seeing a picture. The human vision framework is progressively delicate to color data than dim dimensions so the color is the primary competitor utilized for highlight extraction. A color histogram is one normal technique used to speak to the color substance

RGB color space is the most widely recognized one utilized for pictures on PC since the PC show is utilizing the mix of the essential colors (red, green, blue) to show any apparent color. Every pixel on the screen is made out of three which is animated by red, green and blue electron gun independently. [16] In any case, RGB space isn't perceptually uniform so the color separate in RGB color space does not compare to color divergence in observation. [19] Along these lines we like to change picture information in RGB color space to other perceptual uniform space before highlight extraction.in our method, the RGB components of the image are extracted separately.

F. *Texture Feature*

a.) *Local Binary Patterns (LBP):*

LBP is a sort of visual descriptor utilized for characterization in PC vision.LBP operator is frequently utilized to the greyscale picture, where a code is performed for every pixel. But in our proposed system the LBP operator is used for color image for that initially the R, G and B component of the image is extracted separately and stored in a matrix after that the LBP is applied to the R, G, and B components separately. For instance, when thinking about a cell of 3x3 pixels, the focal pixel is looked at to neighbor pixels. Any order of pixels is conceded, be that as it may, thus the begin is the upper left pixel, when utilizing clock-wise course. In the event that the estimation of the center pixel is littler than or on the other hand equivalent to the estimation of the neighbor then an" 1" will be taken into the record, generally a "0" is considered.[17] [19] The resulted value is a binary number that is associated with a pattern. A weight is doled out to every digit of the got double number and a comparing thing can be determined.

b.) *Compound Local Binary Pattern (CLBP)*

The original LBP operator discards the magnitude information of the difference between the center and the neighbor gray values in a local neighborhood. As a result, this method tends to produce inconsistent codes. [18]One example is shown in Figure 3. Here, the 8-bit uniform LBP code (11111111) corresponds to a

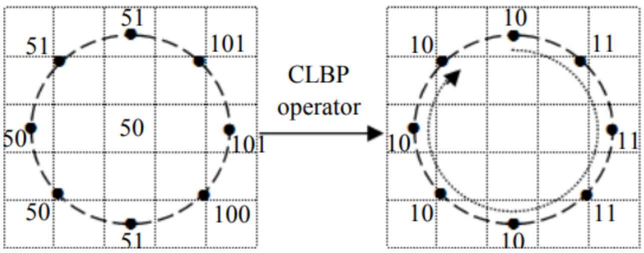

Fig.3.Illustration of the basic CLBP operator. Here, the generated CLBP code is 1011111110101010.

flat area or a dark spot at the center pixel [16], which is not correct in this case.As the LBP operator considers only the sign of the difference between two gray values, it often fails to generate appropriate binary code. Being motivated by this, we propose CLBP, an extension of the original LBP operator that assigns a 2P-bit code to the center pixel based on the gray values of a local neighborhood comprising P neighbors. Unlike the LBP that employs one bit for each neighbor to express only the sign of the difference between the center and the corresponding neighbor gray values, the proposed method uses two bits for each neighbor in order to represent the sign as well as the magnitude information of the difference between the center and the neighbor gray values. Here, the first bit represents the sign of the difference between the center and the corresponding neighbor gray values like the basic LBP pattern and the other bit is used to encode the magnitude of the difference with respect to a threshold value, the average magnitude (Mavg) of the difference between the center and the neighbor gray values in the local neighborhood of interest.

[19] The CLBP operator sets this bit to 1 if the magnitude of the difference between the center and the corresponding neighbor is greater than the threshold M_{avg}.Otherwise, it is set to 0. Thus, the indicator s(x) of (2) is replaced by the following function:

$$s(i_p, i_c) = \begin{cases} 00 \; i_p = i_c < 0, |i_p - i_c| \le M_{avg} \\ 01 \; i_p = i_c < 0, |i_p - i_c| > M_{avg} \\ 10 \; i_p = i_c \ge 0, |i_p - i_c| \le M_{avg} \\ \quad 11 \;\; Otherwise \end{cases} \tag{8}$$

Here, ic is the gray value of the center pixel, ip is the gray value of a neighbor p, and Mavg is the average magnitude of the difference between ip and ic in the local neighborhood.

G. *Statical Feature*

a.) Mean

Mean is the average of all pixels of an image. It works on a sliding window by ascertaining the normal value of all pixel esteems inside the given window and finally supplanting the middle pixel esteem in the goal picture with the outcome. Its numerical definition is explained as

$$MEAN = \frac{1}{mn} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} f(i,j)[19] \tag{9}$$

b.) Standard Deviation (Std):

Standard Deviation is the widely in statistics. As far as picture handling it indicates the level of variety or "scattering" available from the normal (mean or anticipated esteem. [19] A low Std gives the information directs incline toward being very near the mean, while elevated expectation deviation shows that the information calls attention to spread out over an enormous scope of qualities. Mathematically standard deviation is given by

$$\check{f} = \sqrt{\frac{1}{mn-1} \sum_{(r,c)\in W} \left(g(rc,c) - \frac{1}{mn-1} \sum g(r,c)\right)^2} \tag{10}$$

A filter related to standard deviation calculates the standard deviation and finally assigns that value to the center pixel of the image in the output map. It can also be used in edge sharpening and can be very useful for different radar images. The interpretation of radar images is very difficult because of backscatter it cannot rely on spectral values. To recognize some patterns a standard deviation filter is used.

c.) Variance

Variance is used to classify into different regions by calculating how each pixel varies from the neighboring pixel (or center pixel) and is used in classify into different regions. [19]

$$VARINACE = \frac{1}{MN} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} f(i,j) - \bar{f}(i,j) \tag{11}$$

Where $\bar{f}(i,j)$ is the mean of the image block

d.) Kurtosis

$$\check{f}(x,y) = \frac{\frac{1}{mn-1} \sum_{(r,c)\in W} \left(\frac{1}{mn-1} \sum_{(r,c)\in W} g(r,c) - \frac{1}{mn-1} \sum_{(r,c)\in W}\right.}{\frac{1}{mn-1} \sum_{(r,c)\in W} \left(\frac{1}{mn-1} \sum_{(r,c)\in W} g(r,c) - \frac{1}{mn-1} \sum_{(r,c)\in W}\right.} \tag{12}$$

A measure of the shape of the probability distribution of a real-valued random variable is defined in statistics, kurtosis [9]. [14] The fourth moment of a distribution is closely related here. A high kurtosis has longer, fatter tails, and a very sharper peak. A low kurtosis distribution has a more rounded peak ,shorter and thinner tails,.

H. *Support Vector Machine*

In AI, SVM are coordinated learning models that ought to have related learning figuring should use the data and see structures for portrayal and backslide examination SVM can perform either straight or non-direct arrangement. Shows how basic leadership is performed in SVM. In supervised training, the preparation information comprises an arrangement of preparing cases, where every illustration is a couple comprising of information and expected yield esteem. [20] A regulated learning algorithm investigates the preparation information and after that predicts the right classification forgiven informational index input. For example, the teacher teaches the student to identify orange and lemon by giving some features of that. Next time when the student can see lemon or orange can easily classify the object based on his gaining from his educator, this is called directed learning.

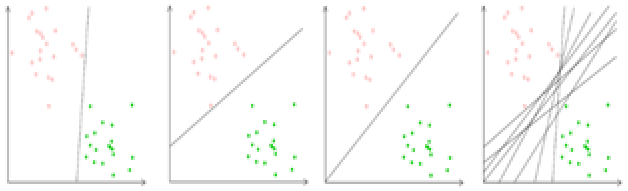

Fig.4. SVM

One can perceive the article just if it is lemon or orange, yet if the given inquiry was grapes the understudy can't recognize it The Margin of a quick classifier has the width by which the length of the purpose of imprisonment can be reached out before hitting the information explanations behind asubstitute course of action. The line is protected to pick having the most astounding edge between the two datasets. The information focuses which lie on the edge are called Support Vectors. The subsequent stage is to discover the hyperplane which best isolates the two classes. SVM plays out this by taking an arrangement of focuses and part them utilizing diverse application-particular scientific recipes. From that, we can locate positive and negative hyperplane. Figure 4. Shows how support vectors are represented in SVM.

The numerical equation for discovering hyperplane is

$$(p.q) + r = +1(positive\ labels) \tag{13}$$

$$(p.q) + r = -1(positive\ labels) \tag{14}$$

$$(p.q) + r = 0(hyper\ labels) \tag{15}$$

we can find the values of P and r using the above equation and linear algebra. Thus, we get the answers for p and r with a margin value of $2\sqrt{(k.k)}$. The margin is calculated as follow

$$\text{Margin} = 2/2\sqrt{(k.k)} \tag{16}$$

In SVM, this model to categorize new data. With the above functional solutions and calculated marginal value, new data can be categorized into a different category level. The following figure demonstrates the margin and SV for linearly separable data.

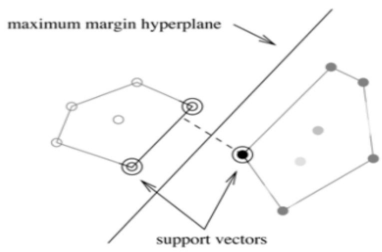

Fig 5. Maximum margin and support vectors for the given datasets.

IV. RESULT AND DISCUSSION

The proposed skin cancer detection model is implemented in MATLAB 2018a in an i5 system with 4 GB RAM. In this work, we have used the PH[2] database. Performances of the model is measured in terms of Total Accuracy (TAcc), sensitivity (San), specificity (Spec), Positive Predicted Value (PPV) and Negative Predicted Value (NPV). For the analysis purpose, our method is analyzed with the existing methods. The resultant graphs with respect to detection performance are given below. Additionally, Fig 6 shows the sample images used in the Image retrieval model.

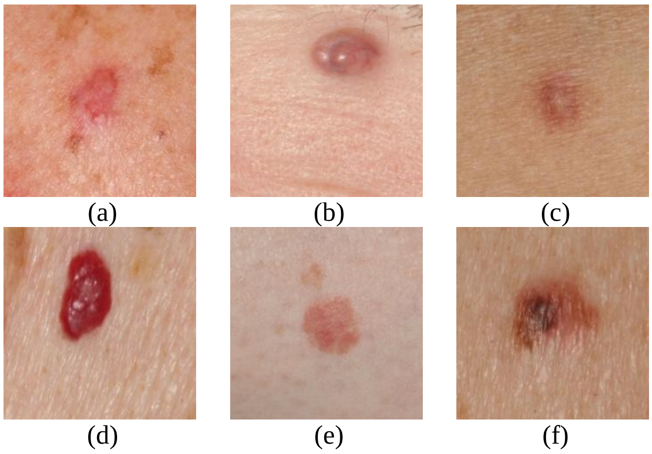

Fig. 6. (a)-(f) Sample input images

A. *Dataset*

This image database contains a total of 200 dermoscopic images of melanocytic lesions, including 80 common nevi, 80 atypical nevi, and 40 melanomas. The PH² database includes medical annotation of all the images namely medical segmentation of the lesion, clinical and histological diagnosis and the assessment of several dermoscopic criteria. The assessment of each parameter was performed by an expert dermatologist.

B. *Evaluation Metrics*

a.) Accuracy

Accuracy of a system is defined as the ratio between a number of correct predictions to the total number of predictions. Table -Ishow that the proposed system yields high accuracy rather than the other methods.

$$Accuracy = \frac{Tp + Tn}{(TP + TN + FP + FN)} \tag{17}$$

b.) Sensitivity

Sensitivity is defined as the ability to respond toaffective changes in the input data. From the table, it is clear that our proposed method has more sensitivity than the other existing methods

$$sensitivity = \frac{Tp}{Tp + Fn} \tag{18}$$

c.) Specificity

Specificity is defined as the ability of a system to correctly segment the images is called specificity. The proposed system produces the maximum specificity of 91.

$$specificity = \frac{Tn}{Tn + FP} \tag{19}$$

d.) Positive predictive value

Positive predictive value is the probability that subjects with a positive screening test truly have the disease.

$$PPV = \frac{number\ of\ True\ Positive}{number\ of\ Positive\ Calls} \quad (20)$$

e.) *Negative predictive value*

Negative predictive value is the probability that subjects with a negative screening test truly don't have the disease.

$$NPV = \frac{number\ of\ True\ Negative}{number\ of\ Negative\ calls} \quad (21)$$

C. *Results*

Color is the most important feature of the colored image, and when you deal with colored images to extract some information the image must be split the colored image according to its type of representation (e.g. RGB or HSV, etc.,) to process the pixel intensity values. Fig.7. shows the separated Red Component (a), Green component (b), Blue Component (c) in RGB color space and Hue Component (d), Saturation component (e) and Intensity Component (f) in HIS color space.

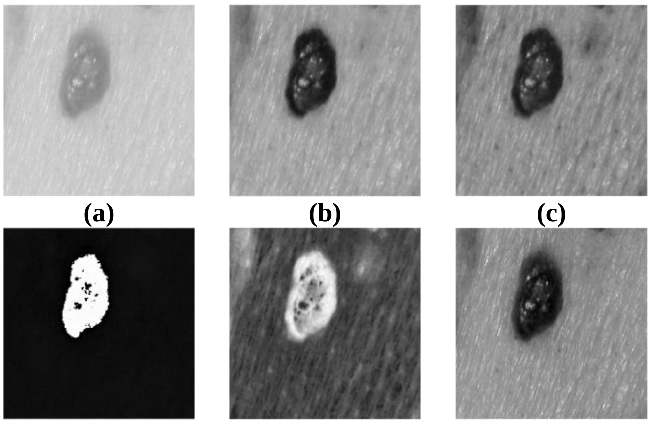

Fig.7. (a) Red Component, (b) Green component, (c) Blue Component(d)Hue Component, (e) Saturation component, (f) Intensity Component

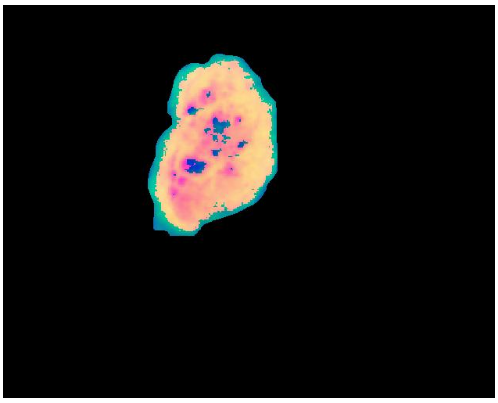

Fig. 8. HIS color component of Segmented image

Table I shows the segmentation performance of the proposed method for the input melanoma images our proposed method is compared with another existing method. Among all the method proposed method performs better than other methods. Fig.8. shows the segmented input images which have melanoma.

TABLE-I
SEGMENTATION PERFORMANCE

Methods	Sen	Spec	PPV	NPV	TAcc
[20]	84	72	70	87	77
[31]	82	71	67	85	76
ANN	80	69	68	84	75
Prop	93	91	93	23	95

V. CONCLUSION

In this paper, a highly accurate Melanoma Detection and classification are performed by using multiple feature extraction and SVM classifier. The input image is preprocessed by using normalization to scale the image. Adaptive gamma correction is applied to improve the contrast of the image. Multiple feature extractions such as color, texture and statistical features are estimated to train the support vector machine. Training and testing are performed separately by using collected sample data. From the evaluation result, it is clear that the proposed algorithm obtained the highest accuracy of 95% percentage it is higher when compared to the conventional algorithms.

REFERENCES

1. Habif TP. Premalignant and malignant nonmelanoma skin tumors. In:Clinical Dermatology: A Color Guide to Diagnosis and Therapy. 6thed. St. Louis, Mo.: Saunders Elsevier; 2016
2. Niederhuber JE, et al., eds. Melanoma. In: Abeloff's Clinical Oncology.
3. 5th ed. Philadelphia, Pa.: Churchill Livingstone Elsevier; 2014.
4. Alfed, Naser, and Fouad Khelifi. "Bagged textural and color features for melanoma skin cancer detection in dermoscopic and standard images." Expert Systems with Applications 90 (2017): 101-110.
5. Maron, Roman C., Michael Weichenthal, Jochen S. Utikal, AchimHekler, Carola Berking, Axel Hauschild, Alexander H. Enk et al. "Systematic outperformance of 112 dermatologists in multiclass skincancer image classification by convolutional neural networks." European Journal of Cancer 119 (2019): 57-65.
6. Tan, Teck Yan, Li Zhang, Siew Chin Neoh, and Chee Peng Lim."Intelligent skin cancer detection using enhanced particle swarmoptimization." Knowledge-Based Systems 158 (2018): 118-135.
7. Kaur, Prabhpreet, Gurvinder Singh, and Parminder Kaur. "Intellectual detection and validation of automated mammogram breast cancer images by multi-class SVM using deep learning classification." Informatics in Medicine Unlocked (2019): 100151.
8. Automatically Early Detection of Skin Cancer: Study Based on Neural Network Classification Ho Tak Lau, Adel Al-Jum
9. Mahmoud Elgamal, AUTOMATIC SKIN CANCER IMAGES CLASSIFICATION, (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 4, No. 3, 2013
10. Esperanza Guerra-Rosas1, and Josué Álvarez-Borrego3, Methodology for diagnosing of skin cancer on images of dermatologic spots by spectral analysis
11. Nidhal K. EL Abbadi and 2Zahraa Faisal, Detection and Analysis of Skin Cancer from Skin Lesions, International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 19 (2017) pp. 9046-9052
12. DEEP LEARNING BASED SKIN LESIONS DIAGNOSIS, D.A. Gavrilov 1*, N.N. Shchelkunov 1, A.V. Melerzanov 1 The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-2/W12, 2019 Int. Worksh. on "Photogrammetric & Computer Vision Techniques for Video Surveillance, Biometrics and Biomedicine", 13–15 May 2019, Moscow, Russia
13. Damilola A. Okuboyejo, Oludayo O. Olugbara, and Solomon A. Odunaike, Automating Skin Disease Diagnosis Using Image Classification, Proceedings of the World Congress on Engineering and Computer Science 2013 Vol II WCECS 2013, 23-25 October, 2013, San Francisco, USA

14. Arthur Marka, Joi B. Carter, Ermal Toto & Saeed Hassanpour Automated detection of nonmelanoma skin cancer using digital images: a systematic reviewhttps://bmcmedimaging.biomedcentral.com/articles/10.1186/s12880-019-0307-7
15. Lee, Dong-U., Ray CC Cheung, and John D. Villasenor. "A flexible architecture for precise gamma correction." IEEE Transactions on Very Large-Scale Integration (VLSI) Systems 15, no. 4 (2007): 474-478.
16. Caselles, Vicent, Francine Catté, Tomeu Coll, and Françoise Dibos. "A geometric model for active contours in image processing." Numerische mathematik 66, no. 1 (1993): 1-31.
17. Barbu, T. U. D. O. R., A. D. R. I. A. N. Ciobanu, and M. I. H. A. E. L. A. Costin. "Unsupervised color-based image recognition using a LAB feature extraction technique." Buletinul Institutului Politehnic Iaşi, Universitatea Tehnică "Gheorghe Asachi 57 (2011): 33-41.
18. Vatamanu, Oana Astrid, et al. "Content-based image retrieval using local binary pattern, intensity histogram and color coherence vector." 2013 E-Health and Bioengineering Conference (EHB). IEEE, 2013.
19. Sliti, Oumaima, Habib Hamam, and Hamid Amiri. "CLBP for scale and orientation adaptive mean shift tracking." Journal of King Saud University-Computer and Information Sciences 30.3 (2018): 416-429.
20. Hlaing, Chit Su, and Sai Maung Maung Zaw. "Tomato Plant Diseases Classification Using Statistical Texture Feature and Color Feature." In 2018 IEEE/ACIS 17th International Conference on Computer and Information Science (ICIS), pp. 439-444. IEEE, 2018.
21. Tong, Simon, and Edward Chang. "Support vector machine active learning for image retrieval." Proceedings of the ninth ACM international conference on Multimedia. ACM, 2001.

AUTHORS PROFILE

Shiji A S, received the B.E degree from Anna Univeristy , India, in 2005, the M.Tech. degree from MS University, Thirunelveli, India, in 2010. Currently works as Assistant Professor in Narayanaguru College of Engineering Manjalumoodu. Professional member of IFERP, Member in IAENG, Member in IRED, Her research interests include Signal Processing, Image processing, fuzzy sets, neural networks, soft computing and wireless communication.

Helintha Graceline.H, received the B.E degree from Anna Univeristy , India, in 2006, MBA degree from Annamalai University, India in 2014 and she is currently pursuing M.E degree from Narayanaguru College of Engineering Manjalumoodu. Her research interests include Image processing, embedded systems and wireless sensor networks.

Abisha Jey J B, received the B.E and M.E degree from Anna Univeristy , India, in 2017and 2019. She is currently working as Assistant Professor in Narayanaguru College of Engineering Manjalumoodu. Her research interests include VLSI design, Image processing, and embedded systems.