iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** II **Month of publication:** February 2023

DOI: https://doi.org/10.22214/ijraset.2023.49231

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue II Feb 2023- Available at www.ijraset.com

A Review on Melanoma Cancer Detection Using Artificial Intelligence

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Abstract: ***The melanoma skin cancer is the most dangerous cancer detected till the date. The reason is as it is difficult for dermatologists or physicians to detect it at early stages, an AI based system is required to detect the melanoma skin cancer at early stage. Skin cancer is one of the fatal diseases of which patients are increasing day by day. It can be easily cured if identified in early stages. Skin cancer is primarily brought on by the abnormal proliferation of melanocytic cells. Skin cancer can happen due to genetic disorder or UV exposure on skin which result in black and brown spot on the skin. The three cancers are : squamous cell cancer, melanoma cancer, and basal cell cancer. With early detection, this skin cancer can be completely cured. Before this the traditional method is the biopsy method for diagnosing melanoma which is very painful one and a time-consuming process. This study gives a computer-aided detection system for the early identification of melanoma. In this study, the image processing techniques and algorithms like Support vector machine (SVM), K-Nearest Neighbor (KNN), Convolution Neural Network and Random Forest are used to design an diagnosing system which is efficient.***
Keywords: Melanoma Detection, Pattern Classification, Image Segmentation, Melanoma Skin Cancer, Feature Extraction, SVM Classifier, RF Classifier, KNN Classifier, CNN.

I. INTRODUCTION

Our concept is based on providing the patients and doctors a simple way of assistance from a Machine Learning model to detect melanoma cancer. Detecting cancer early can help prepare patient and the doctors during the treatment procedure. In rural areas, people don't have access to high-tech facilities and labs to detect cancer in its early stage. We want to provide a comfortable way for people to get a better diagnosis to receive a better treatment plan from early stages of cancer.

Biopsy is the long-established method used to detect a skin cancer which is more painful. This technique consumes extra time and cost. That's why, the diagnosis of person's skin cancer is carried out based on computer technologies to solve above issues. In Our proposed system there are four processes to find out the skin cancer. First of all, it takes images from the dataset HAM10000. Second is image pre-processing using Median Filter. Later, Segmentation using K-means clustering. And it is followed by Extraction of features in which using i) LBP, ii) ABCDE rule, iii) GLCM feature. Fourth step is to classify the given image of the dataset either it is a normal or a cancer affected image using different classifiers.

Many studies have shown the effectiveness of using Machine Learning algorithms for detecting Melanoma Cancer from the HAM10000 Dataset images.

Research works show the importance of segmentation and pre-processing the available images for better results from the model. An ensemble approach has also been proposed earlier for predicting the risk of Melanoma Cancer. All these relevant works have formed a base for our work and practical application of a machine learning model to help patients and doctors in detecting melanoma cancer.

II. LITERATURE REVIEW

Muhammad Ali Farooq, Muhammad Aatif Mobeen Azhar, The system was developed based on computer vision algorithms such as ABCDE rule of melanoma, seven-point checklist, CASH algorithm and Menzies method and it is based on modern image processing. The use of these algorithms significantly improved the accuracy of detection and analysis of suspicious skin lesions compared to visual inspection. Recently, with the development of imaging technology and computer vision algorithms, In medical field the interest has increased to minimize the errors and ambiguity in investigation procedure and to provide reliable secondary findings to doctors.

Maen Takruri, Maram W. Rashad have developed a non-invasive automated system based on Support vector machine classifier for detecting melanoma cancer. The system uses features which were extracted from grayscale concurrency matrix (GLCM) of grayscale images of skin lesions and the color features were obtained from the original color image.

Evaluation performed on dataset which consist of digital images both benign and malignant. The accuracy results of the test achieved by the support vector machine classifier used in this experiment is 82.7% for GLCM features, 81.48% for GLCM and color features using ROI segmentation. Moreover, the proposed system using ROI segmentation resulted in a sensitivity of 83.6% for GLCMs and 83.33% for GLCMs and color features. We also obtained a specificity of 80% using GLCM and a specificity of 76.19% for GLCM and color using ROI segmentation.

F.Ercal, M.Moganti, proposed the technique based on the border extraction of the images. The noise presented in the image is removed by using median filter. In addition to that they implemented histogramming as well as rough color segmentation method.one of the conclusion was that chromaticity and spherical transformation had given best result in precision. Thresholding technique is used to distinguish the various and different image components present in image. Boundary detecting algorithm for image is stated which is helpful for color images of the skin cancer that are provided.

Mustafa Qays Hatem, developed the an automated system based on machine learning technique which is going to serve a perfect helper for the physicians that are working in classifying skin lesions. There are four major steps that are implemented given as : image preprocessing, segmentation, feature extraction, and classification. Graphical User Interface (GUI) is used for better user friendly environment which helps in better visualization of statistical data. For this, Matlab is used as the one of the tool to do coding part. A morphological closing is the technique used for preprocessing.

Sushant Kumar, S. Nandhini, Adnan Afridi, Mohammed Abdul Sofiyan, the proposed system classifies human skin cancer according to the dermatoscopic images into seven different types. It solves this problem using the HAM10000 (Human-Against-Machine) dataset. This dataset contains 10000 training images. This technique uses a Random Forest Algorithm to classify skin cancer into its different types.

Chi Mai Luong, Tri Cong Pham, Thi Phuong Nghiem, Van-Dung Hoang, Antoine Doucet, Giang Son Tran, proposed in this paper involves 4 main steps and that are Data processing, feature extraction, melanoma classification, result analysis. Random forest is one of the techniques used in this paper for melanoma classification. Datasets used in this paper are ISIC 2016 and HAM10000.

Kassem MA, Hosny KM, Fouad MM, in this paper author proposed the classification of the human skin wounds(legions) into eight different classes. Those eight classes are squamous cell carcinoma, actinic keratosis, melanocytic nevus, melanoma, vascular lesion, benign keratosis, dermatofibroma and basal cell carcinoma. The proposed system in the study achieves accuracy near about (94.9%), sensitivity (79.8%), specificity (97.0%) and precision approx. (80.3%).

Yap J, Yolland W, Tschandl P, Dermatoscopy is one of the maximum important methods for detecting and classifying pores and skin cancer via imaging. computerized evaluation of these ensuing images can be executed as a technique to assist dermatologists make better choices. this is primarily based on information to make sure that the most efficient course of movement is taken closer to the affected person. This analysis can be facilitated by using new technology such as convolutional neural networks (CNNs).

Rosadi R, Hadi, S.,B. Y., Irawan, B., and Tumbelaka, suggested a simple, effective, and integrated computer vision method used to recognize and analyze the early stages of melanoma. The segmentation, filtering, and localization phases are the three stages that form the foundation of the structure development. The user can divide the entity initially using a variety of color spaces and appealing learning and non-learning strategies. Morphological filters have been correlated for the purpose of removing image noise during the stage of filtering. K-means algorithm and the Associated constituent categorizing is used to categorize items during the localization phase. Melanoma tumor types are determined by an ABCD feature-based score. Skin cancer research has been successfully controlled using online skin cancer tumor photographs.

III. METHODOLOGY

A. *Proposed System*

In this proposed system, For the purpose of classification of skin lesions of melanoma skin cancer various techniques are used. These techniques helped to build intelligent as well as precise decision support system. This System contains four main stages: Image preprocessing, skin lesion segmentation, feature extraction. The whole architecture of model is given in fig .This architecture contains flowchart of the system in which all the processes are going to be carried out. The very first step which is image preprocessing on test images consist of noise removal, augmentation, hair removal and many more.

For the image pre-processing purpose, Median Filter method is used. Whereas K-means clustering technique is used for the image segmentation. It uses different types of distance formulae for calculating distance. Augmentation and morphological techniques are used to reduce noise, enhancement of targeted area, and making it easier to spot by selecting important details. Feature extraction is done by GLCM which stands for Gray Level Co-occurrence Matrix. The GLCM is an arithmetic approach that works mainly on dimensional relationship of small unit of image which is pixel.

The removal of skin lesion is done by ABCD algorithm. The ABCD stands for A - Asymmetry, B - Border, C - Color, and D – Diameter. Feature extraction in done by using ABCD rule. Next part is classification, Classification is done by using 4 various algorithms which are KNN , SVM and RF. KNN stands for K-Nearest Neighbor, CNN stands for Convolutional neural network, RF stands for random forest and SVM stands for Support Machine Vector. Hyperparameter tunning can be done to get more precise result.

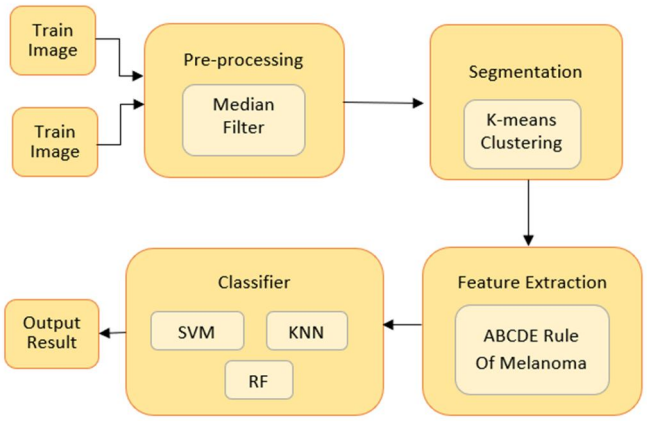

Fig:1 System Architecture diagram

B. Techniques used

1) *Pre-Processing:* The median filter is used for pre-processing in the initial stage. The images are processed through a median filter to remove extra hair, bubbles, and noise. Usually, the image of skin cancer includes fine hair, noise, and bubbles. These are being removed using a median filter because they do not contribute to cancer. The location and amplitude of edges are preserved by median filters. The median filter reduces the variation of the image's intensity by utilizing the neighborhood median to smooth the image.
2) *Median Filter:* The median channel reduces disorder in an image in a manner similar to that of the mean channel. The median channel can be distinguished for two descriptions as in equation median

$$median\ [S(x) + A(x)] \neq median\ S(x) + median\ A(x)$$

The operations of two images are designated by S(x) and A(x). The specific channels have statistics that are really precise and minute. Only the central significance of all surrounding pixel standards is represented by the median. It is highly possible to omit distinct types of disturbance using median filtering.
3) *Segmentation:* The image can be segmented after processing so that it can be used. The segmentation stage accepts the pre-processed image as an input. The segmentation process examines the ridges via k-mean clustering and the outcome is presented.
4) *Feature Extraction:* The next phase in the recognition and classification process is feature extraction. The segmented image isolates the features and thus the GLCM and ABCD rule methodology are used to extract the features.
5) *ABCDE Rule:* The extraction of the cutaneous lesion is done using ABCDE rule-based recognition. The five features stand for A- Asymmetry, B- Border, C- Color, D-Diameter, E-Evolution are retrieved in the subsequent part from the pre-processed image during feature extraction. In the computational analysis of skin cancer, features are extracted using the ABCDE characteristics.

a) *Asymmetry:* Melanoma lesions have an asymmetrical appearance. The asymmetry index has an impact on the entity's degree of symmetry. By dividing the parallel or upright image, this is produced.
b) *Border:* The border of melanoma is crooked, ragged and indistinct. To determine the boundary abnormality, one uses the compactness index.
c) *Color:* Melanomas rarely have a color that is similar to a normal mole. The normalized Euclidean distance between each pixel is

d) Diameter: The melanoma lesion is larger than 6mm in diameter. The diameter in the image is determined and measured at 6mm.

e) Evolution: The spot appears distinct from the others or is evolving in terms of size, shape, or color.

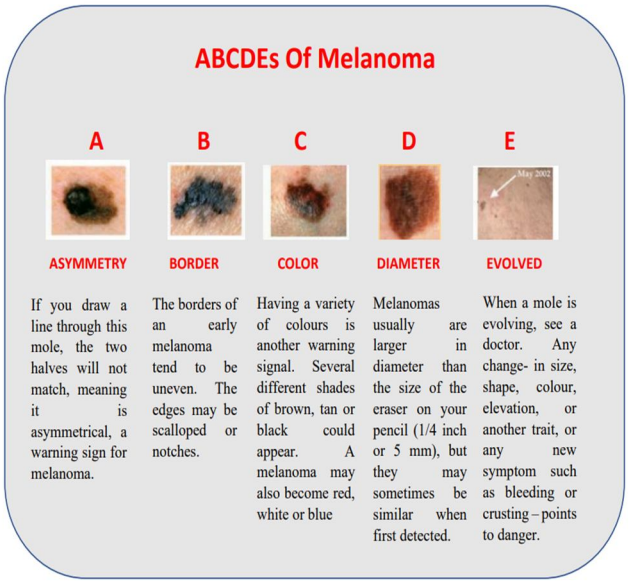

Fig: 2 ABCDEs of Melanoma

6) *Shape Feature:* The abnormality index, irregularity index, and distance from the lesion in the binary image are the characteristics of shape.

7) *Classification:* The final stage of classification divides the images into benign and melanoma categories. Melanoma refers to a tumor image, while benign refers to a normal image. A plan for utilizing support vector machines is offered.

a) Support Vector Machine: Support Vector Machine(SVM) is a supervised learning technique. It is a machine learning technique which is used for not only Classification but also Regression problems. But it is mostly used in Classification problem. We design all data input as a position in n-structural hole with significance of each characteristic being value of an explicit correlation in this SVM algorithm. Support Vector Machine is also known as front line algorithm. SVM is used to finely separate two classes :- 1) hyper-plane and 2) contour.

b) Random Forest: Random Forest is the supervised learning technique. It is a machine learning technique which is used for not only Classification but also Regression problems. For solving a complex problem and improvement the performance of a system . A classifier called random forest uses a variety of decision trees on different subsets of a present dataset to alter the projected accuracy of that particular dataset. The random forest takes the forecast from every tree and bases it on the majority votes of predictions, rather than relying on one or more constrained decision trees. Additionally, it interprets the result. If there are more trees in the forest, the accuracy will increase. It avoids overfitting issues.

c) K-Nearest Neighbor: It is the simplest classification model to use is K Nearest Neighbor. This method recognizes images in the test set by labelling the nearest point in the learning set, where distances are quantified in image space. The Euclidean distance metric is frequently used to gauge how near the data points are to one another in KNN. Every pixel in a dataset is has assigned distance. The distance is the Euclidean distance between two pixels. A KNN classifier by default uses this Euclidean distance. Following the feature extraction procedure, the retrieved features are immediately fed into the classifiers, the machine learning tools, to be divided into two distinct groups. There are two stages to the process: the training phase and the testing phase.

d) Convolutional Neural Networks (CNN): In computer vision, we have convolutional neural networks that are very common in tasks of computer vision such as object detection, image segmentation, and image classification. Image classification is one of the most in-demand technologies today and is used in various fields such as healthcare, business, and more. AI Convolutional Neural Network (CNN) is a type of neural network for processing images. This type of neural network takes input from images, extracts features from images, and provides learnable parameters to efficiently perform classification, recognition, and many other tasks.

C. Plan Of Activation

Initially when an image is transmitted to the system image will be pre-processed using the median filtering method. To segment the pre-processed image K-Mean Clustering will be used. After that, features are extracted from the segmented images using the GLCM feature method, ABCD rule, and shape feature. To find the best results techniques of different classification are used. The classification are divided into three types. The suggested architecture for our research project is shown in Figure 1.

IV. CONCLUSION

This paper discusses the classification and segmentation of skin cancer. Segmentation is a technique used to group input images into regions that are similar to each other. The increased precision of K-means Clustering technology can help section skin lesions cleanly. In this study a new classification technique with the increased stage evaluation is presented. The algorithm which is proposed here uses a supervised learning algorithm, such as a SVM or Random Forest, to compare the performance of three different classifiers, in this case, the SVM, the KNN and the Random Forest. The SVM and Random Forest performed significantly better than the KNN in terms of performance. SVM is effective in detecting bias in training data, even when the sample exhibits some initial bias. Given that the optimality problem is convex, it provides a unique solution. An effective out-of-sample generalisation is offered by artificial intelligence (AI) tools.

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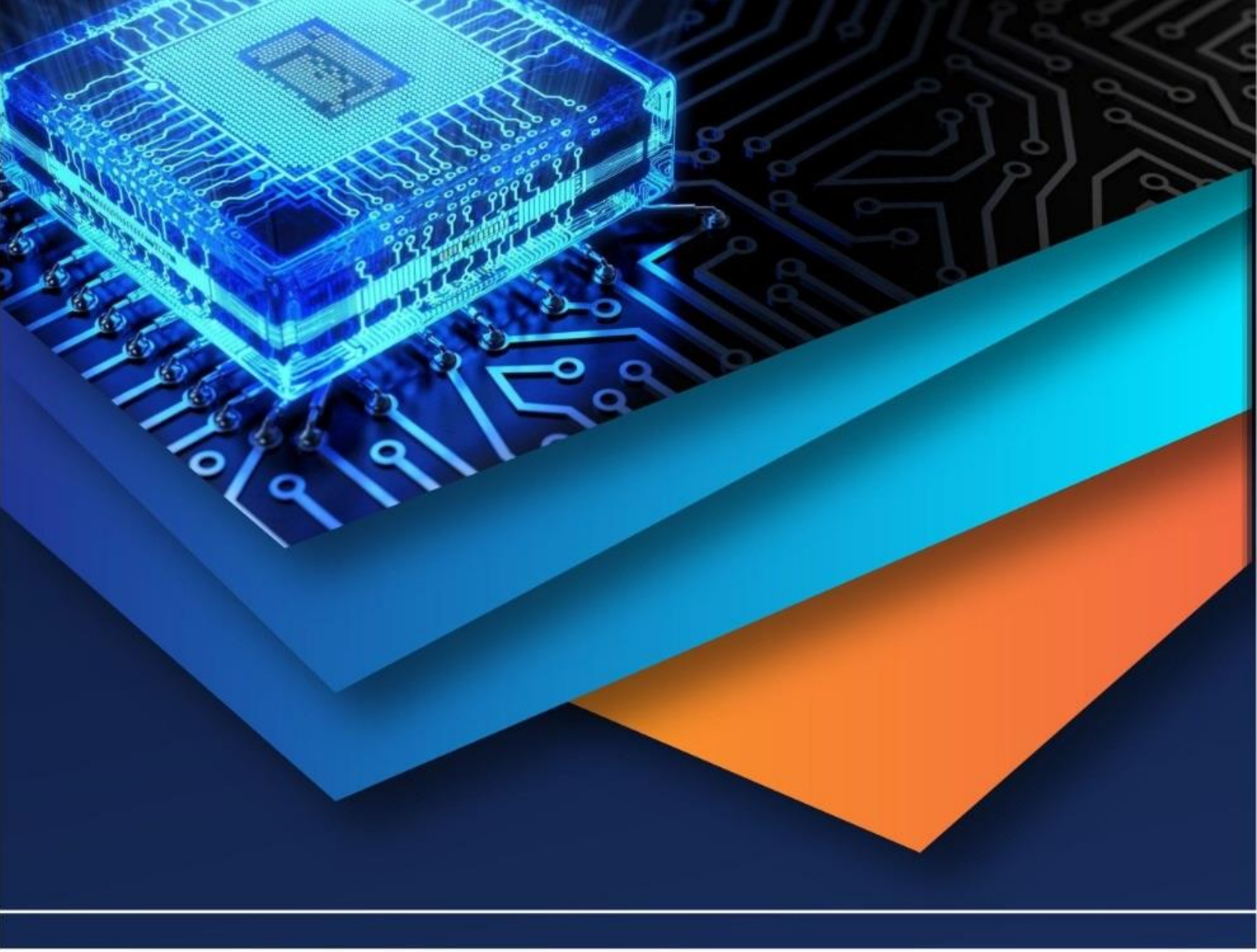

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