Innovative: International Multi-disciplinary Journal of Applied Technology
(ISSN 2995-486X) VOLUME 02 ISSUE 03, 2024

Design And Implementation of a Real Time Skin Cancer Detection System

Fatima Abbas Khaleel
[1]Biomedical Engineering Department, University of Technology

Abstract:

Skin Cancer Detection System Application (SKDSA): is an application that depends on a transfer learning technique that includes a deep learning model (resnet50) and machine learning model (SVM) for the classification of skin images, this technique is used for the early detection method of skin cancer, due to rise cases of skin cancer around the world at a rate more than 1.5 million new cases estimated in 2020 the need increased for a new method for detection of skin cancer with low cost and time.

In this system, the user must provide the image of the affected area, then the input image undergoes pre-processing which includes filtering to remove noise, segmentation to extract the lesion, and then feature extraction by resnet50 network to extract image features, and finally classifier (SVM) to detect the affected area and give predicted classification.

Our project aims to classifying skin images if the image contains skin cancer diseases or not. Enables users to detect and identify types of skin cancer diseases located in images with high accuracy of classification and low cost and less time than other methods of classification such as biopsy. It is an effective method to use for the early detection of real time skin images or loaded skin image on computer.

Keywords: design, implementation, detection, system

Introduction

Skin cancers are the most common group of cancers diagnosed worldwide, with more than 1.5 million new cases estimated in 2020. In 2020, an estimated 325 000 new cases of melanoma were diagnosed

worldwide and 57 000 people died from the disease. There are large geographical variations in melanoma incidence rates across countries and world regions. Malignant melanoma skin cancer is one of the most deadly types of Skin cancer diseases and therefore, essential to recognize skin diseases at an early stage that will help to treat them in a large percentage and prevent them from spreading thus reducing the Prospect of death. In most world regions, melanoma occurs more frequently in men than in women[1] . Human skin is unpredictable and almost difficult terrain for its complexity of sweating, lesion structures, moles, color, presence of thick hair, and other confounding features that affect the early detection of skin diseases by the human eye, new technique used for early detection of skin cancer is artificial intelligence (AI). Artificial intelligence (AI) is a technique used for the early detection of skin cancer, helps to identify affected areas of skin cancer and detect the type with high accuracy and also reduced the cost and time required for classification by other methods consequently reducing the cost of therapy required at a late stage and Prospect of death. Our project depend on using transfer learning is a machine learning method that depends on reuse pre-trained model as the starting point for a model on the task of classification that will give a more accurate result rather use one type of method to classification such as only use CNN model for classification [2].

In our system, we use Convolutional Neural Networks (CNN) or (ConvNet) are a class of deep neural networks basically a generalized version of multi-layer pertained, specifically we use a resnet50 network that is used to extract features and retrain Support Vector Machine (SVM) is a supervised learning machine learning algorithm that can be used for the classification of images after training on images to detect skin cancer types in Matlab. The system is developed and tested with different networks architectures by varying the type of networks that different Convolutional layers, Dropout layers, Pooling layers, and Dense layers, such as Resnet18, Alexnet, and VGG19. We achieved more accurate results of detection using resnet50 compared to other models, the model will be tested and trained on the dataset collected from Skin Cancer MNIST (HAM10000) for malignant and benign skin cancer data set and Monkeypox Skin Images Dataset (MSID) and manually collected dataset for normal skin dataset.

In this system, the user must provide the image of the affected area, then the input image undergoes pre-processing which includes filtering to remove noise, segmentation to extract the lesion, and then feature extraction by resnet50 network to extract image features, and finally classifier (SVM) to detect the affected area and give predicted classification. This study aims to to develop a skin cancer detection method by using transfer learning where we used a resnet50 pre-trained model to train SVM to classify skin images. The system can be used for analyzing the skin image and finding out if it contains cancer diseases and determining it is type.

2.Literature Survey

Skin cancer is a disease caused by changes in the properties of normal skin cells to become malignant, in which cells will continue to divide into abnormal shapes that are uncontrolled due to DNA damage and based on the histopathology view, skin cancer has an irregular structure with cell differentiation in various levels of chromatin, nucleus, and cytoplasm.

Skin cancer is found in 5.9 % to 7.8% of all types of cancer per year even though the number of Malignant Melanoma incidents is smaller than nonmelanoma Cell Carcinoma, the death rate tends to

be greater, which causes 75% of deaths from skin cancer. The most invasive skin cancer is melanoma patient body, which has a high mortality rate, especially if it is not early detected. Non-melanoma skin cancers, such as basal cell carcinoma and squamous cell carcinoma is more common but less metastatic in the patient body, and only partially leads to disability or death but with a low ratio of deaths [3].

Accurate diagnosis and early detection of skin cancer can help the healing process, proper medical treatment, and avoid the worst effects of skin cancer therefore, an early detection system is needed that can facilitate and increase public awareness of identifying types of skin cancer or other skin disorders such as benign tumors on the skin that look very similar to malignant skin cancer.

Automatic skin disorders classification can help people in identifying skin disorders that occur and immediately consult with medical personnel to get an appropriate medical diagnosis and then treatment. Several related studies based on digital image processing for the detection and classification of skin cancers were developed as a tool for medical personnel to diagnose skin disorders more accurately with fast computing time [4].

The causes for skin cancer are environmental and host factors:

Environmental factors associated with skin cancer are sun exposure, ozone depletion, and chemical exposure and the host factors are HPV, genetic susceptibilities, skin tone and immune suppression. Also skin type effect to skin cancer as they may easily get affected by UV-exposure generally fair skin, red and blond hair, blue or green eyes are more susceptible to skin cancer[5].

Skin self-Exam

Many doctors recommend checking your own skin, preferably once a month. Skin self-exams are best done in a well-lit room in front of a full-length mirror and Examine all areas, including your palms and soles, scalp, ears, nails, and your back

(in men, the back is a common place for melanomas to start).See Signs and Symptoms of Melanoma Skin Cancer to learn about what to look for when examining your skin for example any spots on the skin that are new or changing in size, shape, or color [6].

Exam by a health care professional

Some doctors and other health care professionals do skin exams as part of routine health check-ups If your primary doctor finds any unusual moles or other suspicious areas, they may refer you to a dermatologist, which uses techniques such as dermoscopy (also known as dermatoscopy), epiluminescence microscopy [ELM], or surface, after that your doctor send you to do a test for diagnose if it needs [7].

Diagnosing

The two most common types of tests used in diagnosing skin cancer are biopsies and imaging tests.

Biopsy. In many cases, doctor during this procedure, doctor will numb the area before removing a tissue sample. Types of biopsies include a shave biopsy, in which your doctor shaves off the top layers of the lesion, and a punch biopsy, in which theory uses a special tool to cut a tiny round piece of the

tumor, including deeper layers of the skin but an excisional biopsy in which the doctor removes the entire growth is often sufficient to treat the skin cancer.

Imaging tests

Are non-invasive and painless and one of several medical imaging procedures that may be used to determine whether cancer cells have metastasized to internal organs

And bones and include: Computed tomography (CT) scan ,X-ray and Magnetic Resonance Imaging (MRI).

Artificial intelligent (AI)

Artificial intelligent (AI) can be of use for the early detection of skin cancer for example using of deep convolutional neural networks or machine learning can help to develop a system to evaluate images of the skin to diagnose skin cancer and help doctors in diagnosis [8-13].

Detection of skin cancer using MATLAB

The system's diagnosis in Matlab will assist in speeding up and enhancing the accuracy of the diagnosis. Some detail, such as asymmetry, color variation, and texture features, can be extracted by the by algorithm in Matlab; however, these minute parameters may not be visible to the naked eye. An automated dermoscopy image analysis system has three stages: (a) Preprocessing, (b) proper segmentation, and (c) feature extraction.

And the most important critical step is segmentation, which has an effect on the subsequent steps and detection [14-17].

3.Methodology

proposed Methodology

Our model is designed in 3 phases as follows:

Phase1 – the first model involves

A. collection of the dataset, the images are collected from dataset collected from Skin Cancer MNIST (HAM10000) for malignant and benign skin cancer data set and Monkeypox Skin Images Dataset (MSID) and manually collected dataset for normal skin dataset.

Phase 1 also involves the pre-processing of the images where hair removal, glare removal, and shading removal are done

B. Removal of these parameters helps us to identify the texture, color, size, and shape-like parameters in an efficient way.

Phase 2- this phase consists of segmentation and feature extraction,features are extracted for color, shape, size, and texture using a pre-trained Resnet50 network.

Phase 3- this is the most important phase of our model, this phase involves designing the model and training.

Our model SVM (Support Vector Machine) was trained on the dataset that was collected in phase 1 after extracting features from images, the model after training was tested for accurate classification output and we achieved accuracy of training about 95% and accuracy of testing about 90%[18-25].

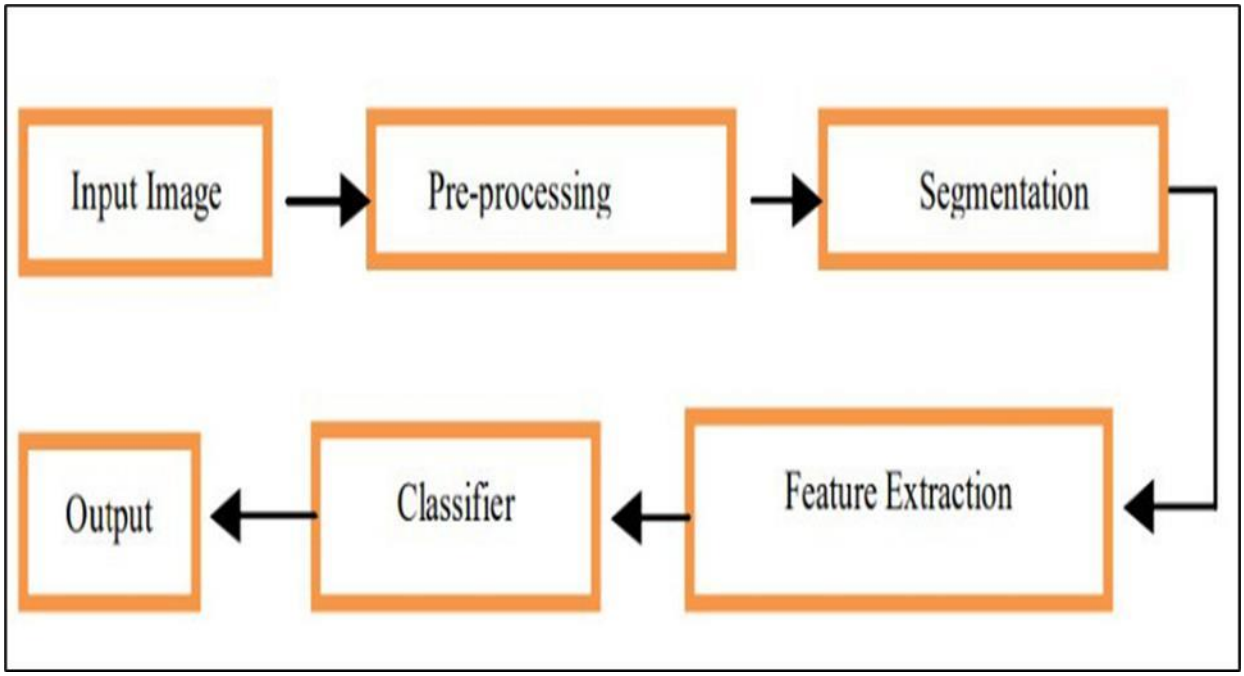

Figure 1 Block diagram of proposed methodology

COMPONENTS OF METHODOLOGY:

A.PRE-PROCESSING:

The pre-processing of images is an important task or activity which helps in saving time for training as well as provides the clear enhancement for further steps by increasing the efficiency of the model.

Pre-processing includes the following:

Collection of the dataset

Hair removal

Shading removal

Glare removal

B. Dataset: The images were collected from Skin Cancer Human Against Machine with 10000 training images (HAM10000) dataset for malignant and benign skin cancer this dataset consists of 10015 dermatoscopic images which can serve as a training or validation or testing set for academic machine learning purposes.

And Monkeypox Skin Images Dataset (MSID) this dataset consists of dermatoscopic images of normal skin, also manual dataset collected a normal skin dataset of about 50 images to acquire more images for train and validation, and testing our model on it.

We use 675 images in the training set to train our model then use 225 images in validation set to test the accuracy of classification of our model.

C. Image Segmentation And Features Extraction The method of segmenting a digital image into multiple segments is known as image segmentation (sets of pixels,also known as image objects) then features extraction as shape, texture, color, etc. are used to describe the content of the image features can be classified into primitives all that done automatically using pertained convolution neural network (CNN) model.

D. Resnet50 is type of Convolutional Neural Network(CNN) model is deep learning algorithm which can take an input image, then separate the various views and objects in the image Furthermore, used to segmentation and features extraction from image.

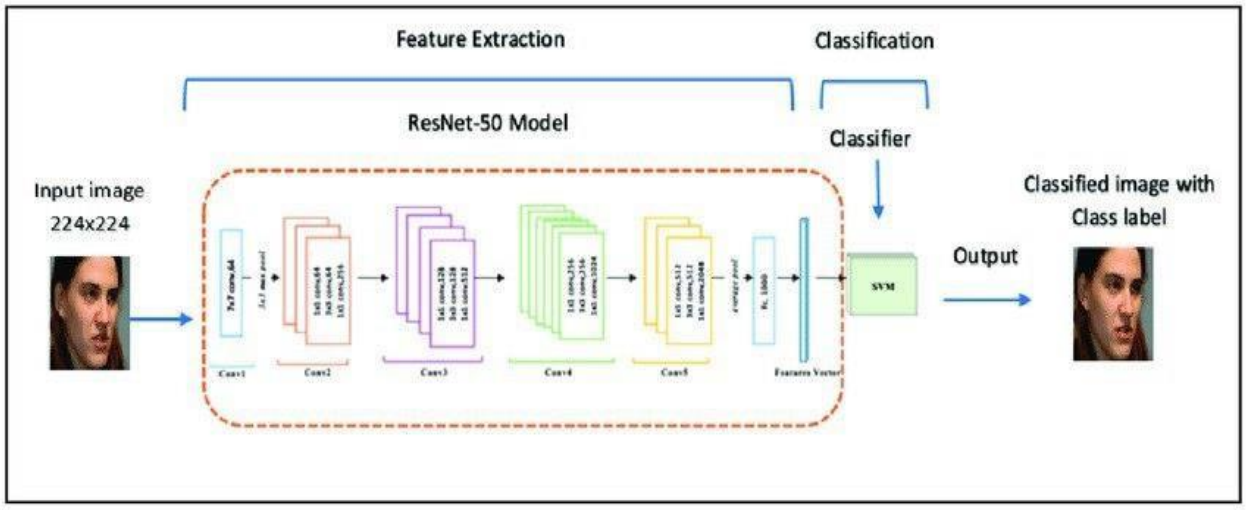

figure 2 Resnet50

E. CLASSIFIERSVM: Support-Vector Machines is a supervised machine learning algorithm that is primarily used to categories data into various groups. A hyper plane is used in SVM to serve as a decision boundary between the different groups. SVM can be used to create several separating hyper planes, splitting the data into segments with only one form of data in each segment.

F. Features of SVM are as follows: SVM is a supervised learning algorithm. This means that SVM trains on a set of labeled data. SVM studies the labeled training data and then classifies any new input data depending on what it learned in the training phase.

Designing The Model

We have used 2 different methods:

We used Convolutional Neural Networks (resnet50 model) to can be directly used for medical image segmentation tasks and feature extraction these extracted feature images from the training set and then passed them for training to find the efficient detection and classification of malignant or benign skin cancer or normal skin then test classifier Support Vector Machine (SVM) on the validation set to ensure accuracy of training and classification.

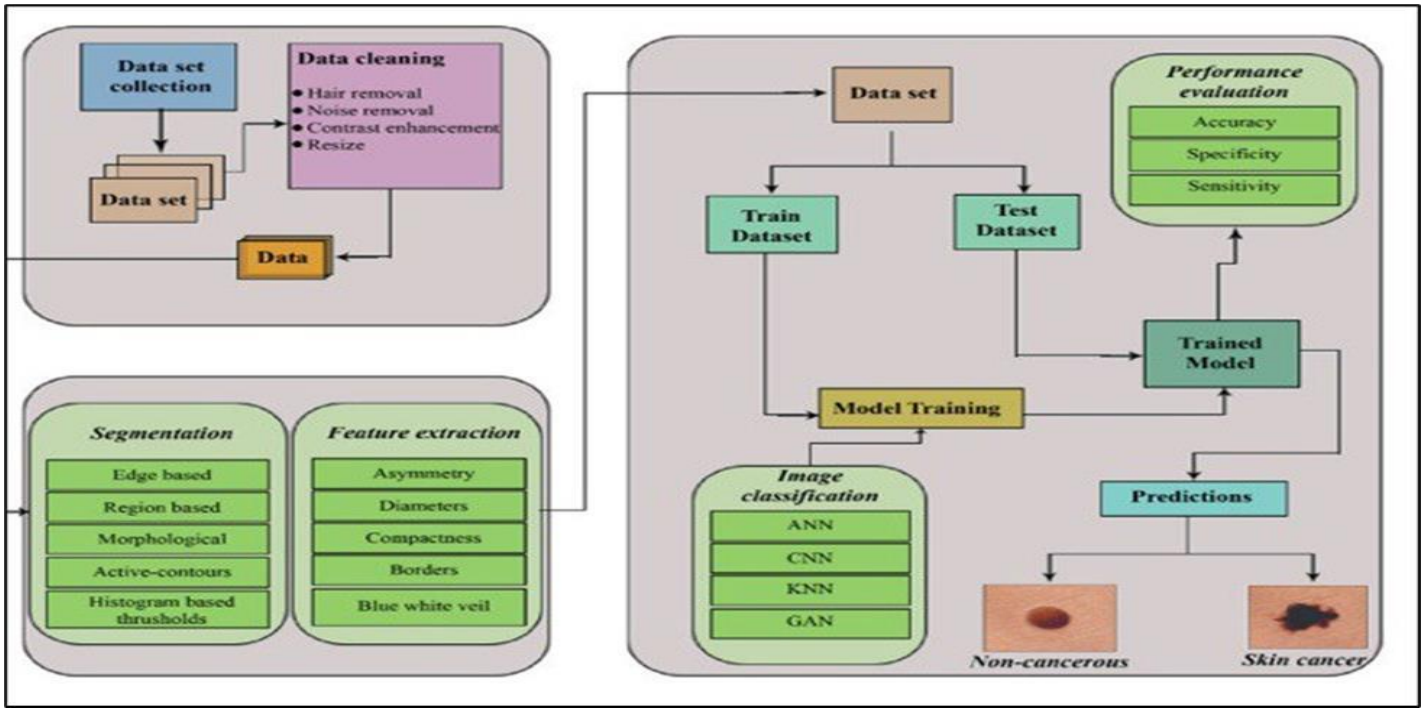

Figure 3 sketch showing the stages of model design.

4.Results & Discussion

In this chapter, an explanation of how to use the MATLAB program as an application to detect cases of skin cancer. With the use of a hardware device (camera) to detect the disease directly by taking a picture through the camera connected to the computer.

Proposed Method

Device connection

1- Connection USB type A wire of camera with HDMI Display port of laptop.

2-Put the camera on the screen of laptop.

3- Put the camera on the screen of laptop for more flexible to take photo.

The procedure

1- click on the application of skin cancer detection system app to open.

2-the application loading to open.

3- then the user interface of the application it open automatically.

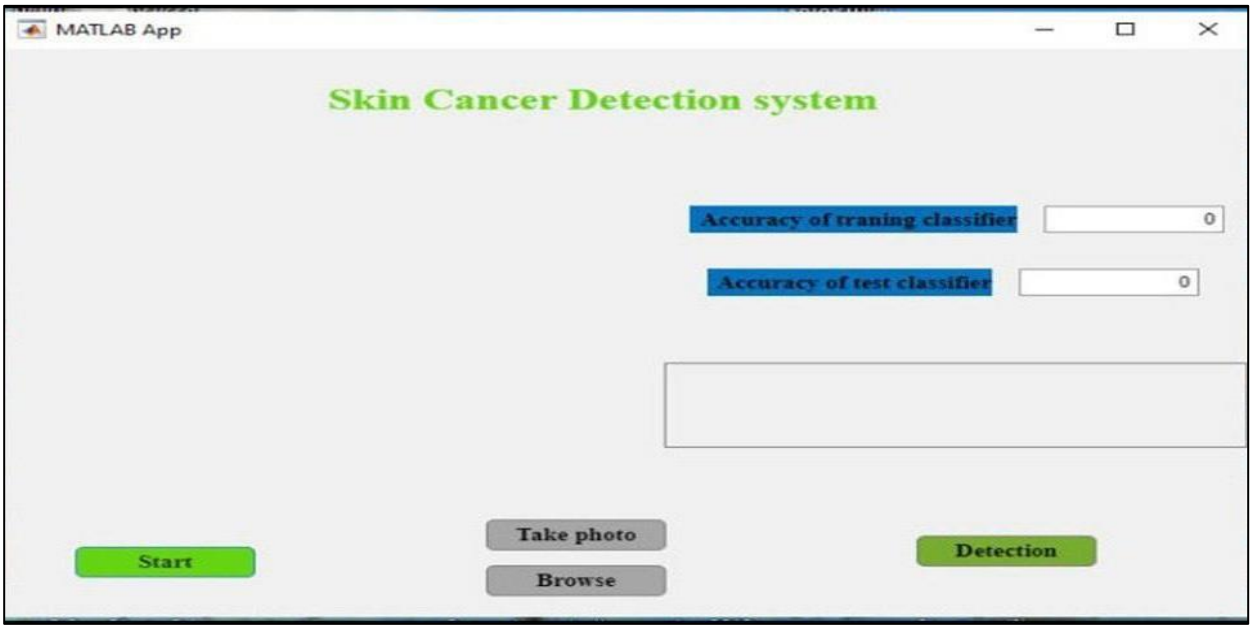

Figure 4 the user interface 4- Click the Start button to run the application.

5- after that accuracy of trained classifier will show.

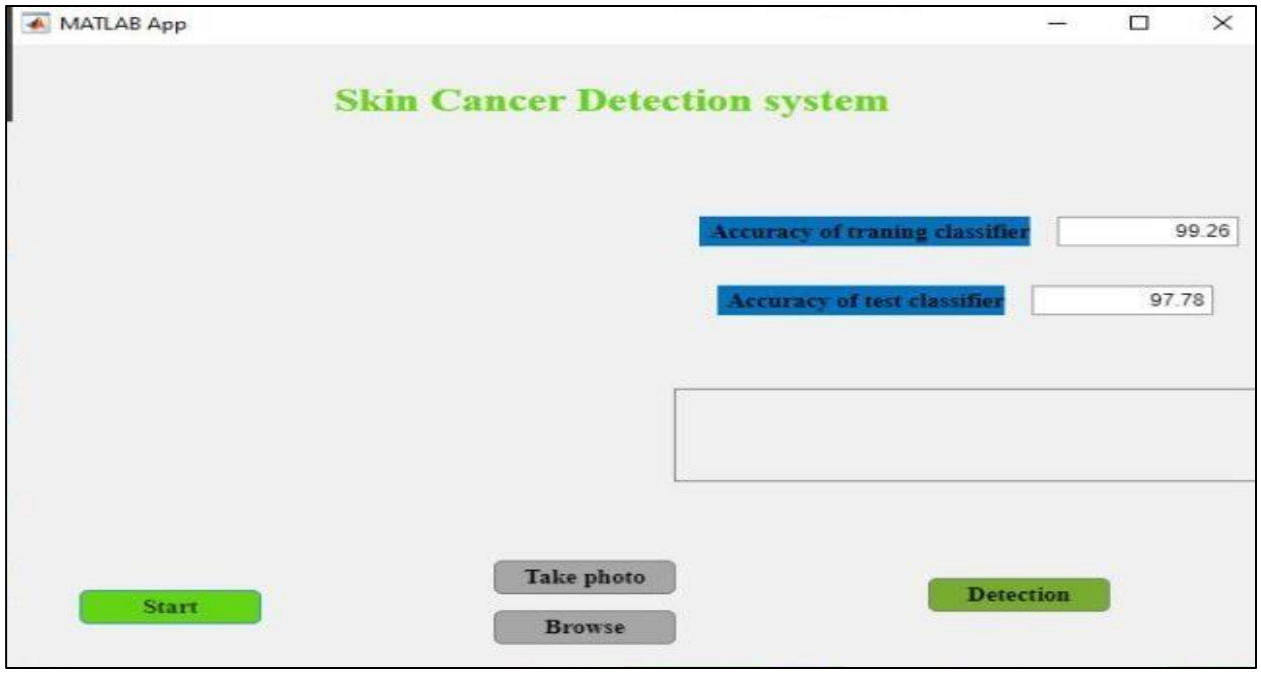

Figure 5 after that accuracy of trained classifier

6- if want to classify a real-time image click on take photo button.

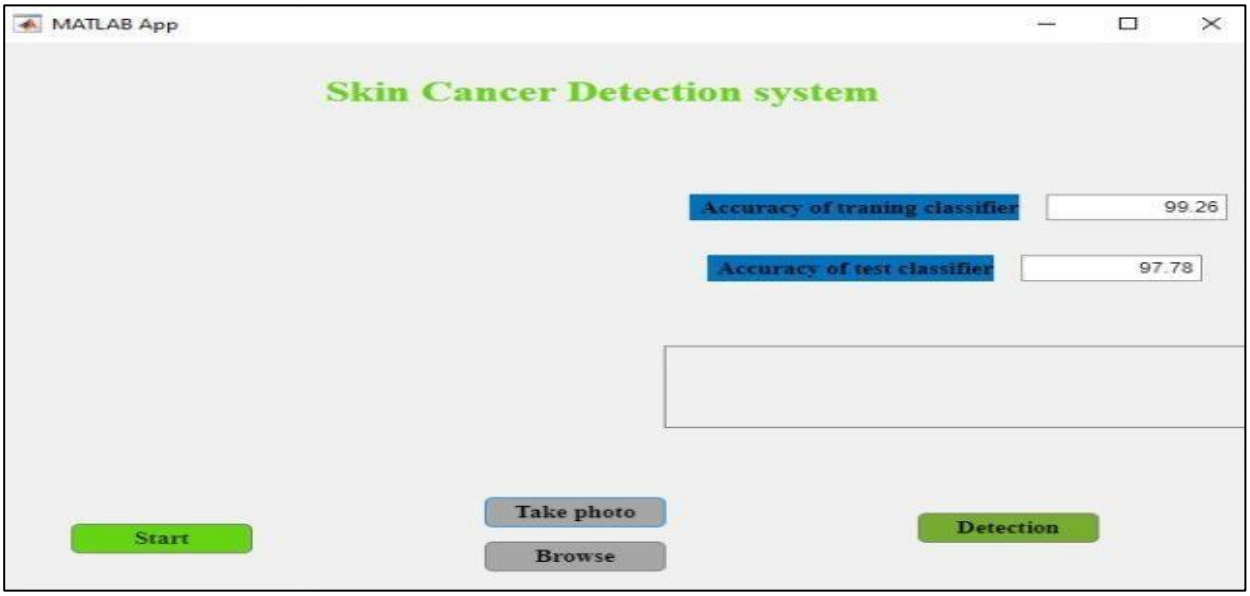

Figure 6 classify a real-time image click on take photo button 7- the result of skin cancer show in text box and little box.

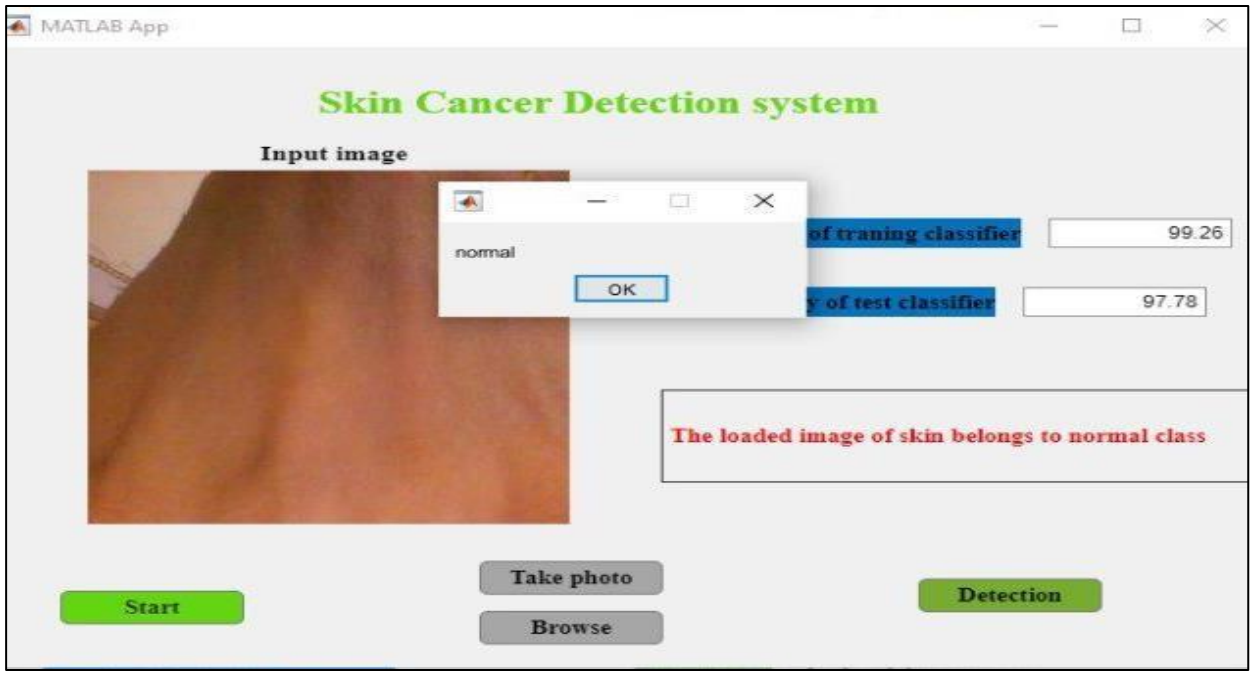

Figure 7 result of skin cancer show in text box and little box

8- if want to classify loaded image click on Browse button.

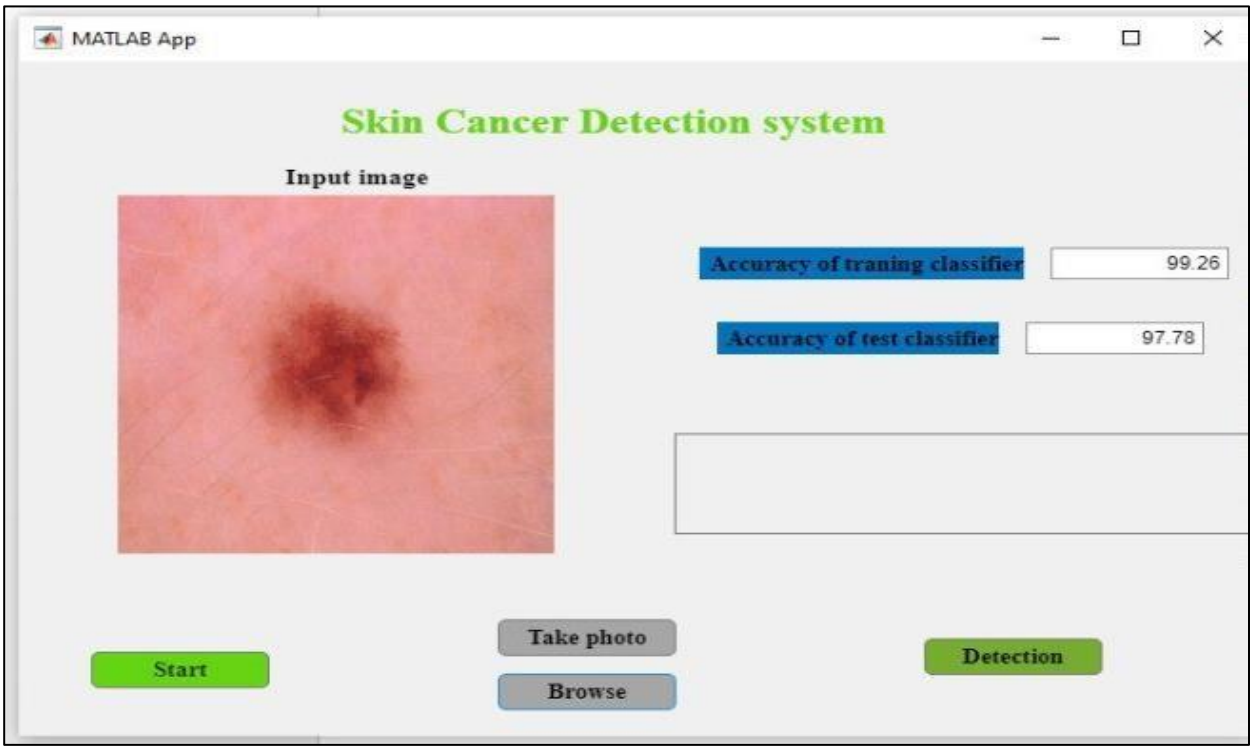

Figure 8 classify loaded image

9- We can choose any image from any file loaded on computer.

10- from testing set we can chose image.

11- now the selected image can classify by click on detection button.

12- the result of skin cancer show in text box and little box.

13-if user want to chose image from any file on computer.

14-Chose file then chose any image want to classify it for example from download file we chose this image and click open to use it as input image to system

Discussion

The majority of studies on the quality of oncologic pathology diagnoses have focused on patient safety and have documented a variety of causes of error that occur in the clinical and pathology laboratory testing phases of diagnostic testing and it can include:

1- role of Clinical practitioners they have an essential role in error reduction through several avenues such as effective test ordering, providing accurate and pertinent clinical information, procuring high-quality specimens, providing timely follow-up on test results, effectively communicating on potentially discrepant diagnoses, and advocating second opinions on the pathology diagnosis in specific situations[25-27].

2- No-fault diagnostic errors (nonpreventable errors) may occur when signs of disease are atypical or absent.

Diagnostic errors are often attributable to preventable factors such as cognitive errors (eg, faulty information synthesis or clinical reasoning) so the artificial intelligent can be useful to reduce the error in cancer detection also reduce cost and time require for cancer diagnosis. Also it can use it as primary detection method for cancer disease [28-31]. although the artificial intelligent not free error but limited and it include processingrelated errors in data capture, coding, editing , and reduce possible of that errors by using deep learning algorithms such as CNN ,also tabulation of the data and using similar or almost similar images of different categories in dataset it can effect on accuracy of classification but general the classification of cancer by CNN it conceder high accuracy about 97%.

Results

In our work, we have used the Matlab app, a webcam connected to the laptop by USB wire to connect with the Matlab app and capture photos in real-time or use a loaded image from the test set in the

dataset and analyze input image using pretrained Convolutional Neural Network model (Resnet50) as a feature extractor then reuse it for train machine learning model (SVM).

After training the Restnet 50 for features extraction from image using the feature layer is a good place to start to extract features in the net, this layer is named 'fc1000'.

Next, use the CNN image features to train a multiclass SVM classifier. A fast Stochastic Gradient Descent solver is used for training by setting the fitcecoc functions, this helps speed up the training when working with high-dimensional CNN feature vectors. Then we repeat the procedure used earlier to extract image features from validation Set then validation features can then be passed to the classifier to measure the accuracy of the trained classifier.

We calculate accuracy by dividing the number of correct predictions (the corresponding diagonal in the matrix) by the total number of samples. The result tells us that and gives high accuracy of trained about 99% and accuracy of the test classifier about 96%.

The accuracy of test of trained classifier is show in confusion matrix

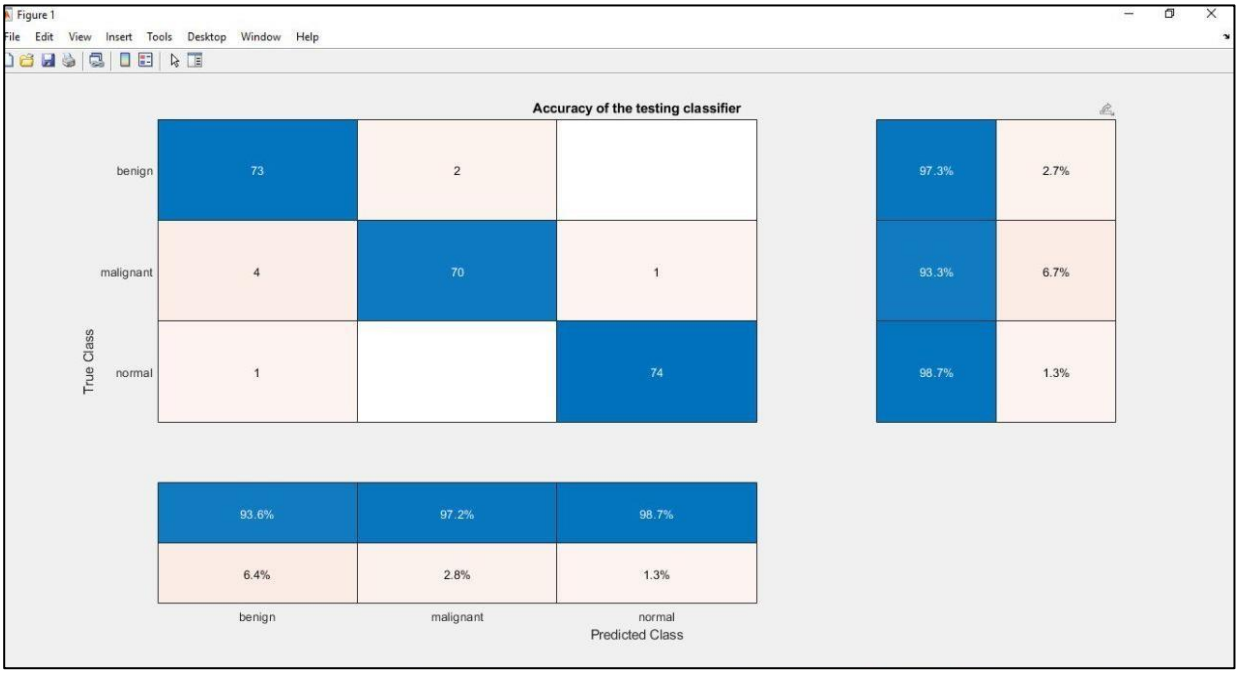

Figure 9 confusion matrix of accuracy of testing classifier

The confusion matrix displays the total number of observations in each cell.

A row-normalized row summary displays the percentages of correctly and incorrectly classified observations for each true class. A column-normalized column Summary displays the percentages of correctly and incorrectly classified observations for each predicted class.

This is because AI does not give 100% accuracy and it can happen because images classified as malignant skin cancer may be similar in appearance to melanoma classified as benign skin cancer.

Sometimes it is difficult to determine its type even when using medical diagnosis and biopsy because of the similarity.

Likewise, large and strangely shaped moles or natural birthmarks can be classified as skin cancer of the malignant or benign type, but despite the percentage of error that the trained classifier expected, it is considered a small percentage, has high measurement accuracy, and good reliability. Therefore, this method can be used as a preliminary detection method for skin conditions before conducting an examination medical or biopsy

and we use this equation to calculate Accuracy of test classifier where the accuracy = Number of Correct Predictions / Total Number of Predictions and we have accuracy of test trained classifier = 74+73+70/74+70+73+5+2+1== accuracy=0.96*100%== 96%.

5. Conclusion

In this project, images from a Skin Cancer detection Dataset are classified into categories using a multiclass linear SVM trained with CNN features extracted from the images. Where this approach to image category classification follows the standard practice of training an off-the-shelf classifier using features extracted from images rather use hand-crafted features such as HOG, LBP, or SURF. (Hand Crafted" features refer to properties derived using various algorithms using the information present in the image itself. For example, two simple features that can be extracted from images are edges and corners). The difference here is that instead of using image features such as HOG or SURF, features are extracted using a CNN that outperforms and that will give a more accurate result. Each layer of a CNN produces a response, or activation, to an input image. However, there are only a few layers within a CNN that are suitable for image feature extraction. The layers at the beginning of the network capture basic image features, such as edges and blobs. These "primitive" features are then processed by deeper network layers, which combine the early features to form higher-level image features. These higher-level features are better suited for recognition tasks because they combine all the primitive features into a richer image representation. Next, use the CNN image features to train a multiclass SVM classifier. A fast Stochastic Gradient Descent solver is used for training by setting the fitcecoc function's 'Learners' parameter to 'Linear'. This helps speed up the training when working with high-dimensional CNN feature vectors then the test features can then be passed to the classifier to measure the accuracy of the trained classifier.

after that Apply the Trained Classifier On One Test Image that you can take by a webcam connected to a Matlab desktop or browse loaded images from a test set in dataset and classify it then take the result if the image contains skin cancer the result will be (malignant, or, benign) if the image was not contain skin cancer the result will be (normal)

References

1. Vicente, A.L.S.A., Novoloaca, A., Cahais, V. et al. Cutaneous and acral melanoma cross-OMICs reveals prognostic cancer drivers associated with pathobiology and ultraviolet exposure. Nat Commun 13, 4115 (2022).

2. BENYAHIA, Samia; MEFTAH, Boudjelal; LÉZORAY, Olivier. Multi-features extraction based on deep learning for skin lesion classification. Tissue and Cell, 2022, 74: 101701.
3. FU'ADAH, Yunendah Nur, et al. Convolutional neural network (cnn) for automatic skin cancer classification system. In: IOP conference series: materials science and engineering. IOP Publishing, 2020. p. 012005.
4. FABBROCINI, Gabriella, et al. Epidemiology of skin cancer: role of some environmental factors. Cancers, 2010, 2.4: 1980-1989.
5. SAVERA, Teresia R.; SURYAWAN, Winsya H.; SETIAWAN, Agung Wahyu. Deteksi Dini Kanker Kulit menggunakan K-NN dan Convolutional Neural Network. Jurnal Teknologi Informasi Dan Ilmu Komputer, 2020, 7.2: 373-378.
6. GUPTA, Alpana K.; BHARADWAJ, Mausumi; MEHROTRA, Ravi. Skin cancer concerns in people of color: risk factors and prevention. Asian Pacific journal of cancer prevention: APJCP, 2016, 17.12: 5257.
7. PRABHU, Dr, et al. A Case of Squamous Cell Carcinoma. Digital Journal of Clinical Medicine, 2020, 2.5: 9.
8. VEJSELI, Hatidže. Značaj scintigrafije limfnog čvora stražara kod malignog melanoma trupa. 2020. PhD Thesis. Josip Juraj Strossmayer University of Osijek. Faculty of Medicine Osijek. [8] Artificial Intelligence-Based Image Classification for Diagnosis of Skin Cancer: Challenges and Opportunities Manu Goyal1 , Thomas
9. Knackstedt2 , Shaofeng Yan3 , and Saeed Hassanpour
10. MADOOEI, Ali; DREW, Mark S. Incorporating colour information for computer-aided diagnosis of melanoma from dermoscopy images: A retrospective survey and critical analysis. International journal of biomedical imaging, 2016, 2016.
11. KRISHNA, M. Chaithanya; RANGANAYAKULU, S.; VENKATESAN, DR P. Skin cancer detection and feature extraction through clustering technique. International
12. Journal of Innovative Research in Computer and Communication Engineering, 2016, 4.3: 8.
13. FORNACIALI, Michel, et al. Statistical learning approach for robust melanoma screening. In: 2014 27th SIBGRAPI Conference on Graphics, Patterns and Images. IEEE, 2014. p. 319-326.
14. Comparison between Convolutional Neural Network CNN and SVM in Skin Cancer Images Recognition Zaid G. Hadi1*, Ahmed R. Ajel1, AyadQ. Hussain1
15. SHAHI, Preeti, et al. Melanoma skin cancer detection using various classifiers. In: 2018 5th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON). IEEE, 2018. p. 1-5.
16. Miss. Rupali S. Awhad1 , Dr. Seema S. Kawathekar A Review on Melanoma
17. Skin Cancer Detection Using Digital Image Processing
18. VIJAYALAKSHMI, M. M. Melanoma skin cancer detection using image processing and machine learning. International Journal of Trend in Scientific Research and Development (IJTSRD), 2019, 3.4: 780-784.
19. https://www.amazon.in/Rapoo-Horizontal-Wide-Angle-Microphone-
20. Conference/dp/B08KHNZXV7
21. Natick, Massachusetts, United States - (15 Mar 2022) MathWorks Introduces
22. Release 2022a of MATLAB and Simulink
23. [17]https://www.mathworks.com/matlabcentral/fileexchange/64626-deep-learning- toolbox-model-for-resnet-50-network
24. [18]https://www.mathworks.com/matlabcentral/fileexchange/45182-matlab- support-package-for-usb-webcams
25. Miss. Rupali S. Awhad1, Dr. Seema S. Kawathekar2A Review on Melanoma

26. Skin Cancer Detection Using Digital Image Processing
27. https://www.mathworks.com/products/matlab/app-designer.html
28. https://www.mathworks.com/help/matlab/getting-started-with-matlab.html [22] https://www.mathworks.com/help/deeplearning/applications.html

29. [23]https://www.mathworks.com/help/deeplearning/deep-learning- fundamentals.html
30. [24] https://www.mathworks.com/help/deeplearning/image-data-workflows.html [25]https://www.mathworks.com/help/deeplearning/sequence-and-numeric- feature-data-workflows.html
31. https://www.mathworks.com/help/deeplearning/parallel-and-cloud.html
32. 23-NEIDINGER, Richard D. Introduction to automatic differentiation and MATLAB object-oriented programming. SIAM review, 2010, 52.3: 545-563. [28]https://www.mathworks.com/help/deeplearning/deep-learning-code generation-from-matlab-applications.html
33. [29]https://www.mathworks.com/help/deeplearning/function-approximation clustering-and-control.html
34. CA Cancer J Clin 2010;60:139–165. © 2010 American Cancer Society, Inc
35. Errors in Cancer Diagnosis: Current Understanding and Future Directions
36. Hardeep Singh, Saurabh Sethi, Martin Raber, and Laura A. Petersen
37. Journal of Clinical Oncology 2007 25:31, 5009-5