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Skin Cancer Detection Using Machine Learning

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Abstract: ***Skin-related issues often serve as indicators of underlying health problems in other parts of the human body, adversely affecting an individual's overall fitness and well-being. However, such issues are frequently ignored, as they are perceived to be either painless or have minimal to no impact on daily life. To address this challenge, this system was developed with the aim of early detection of skin cancer. The system enables users to upload images or videos of the affected area in real-time, utilizing a skin cancer detector to identify existing conditions, determine the cancer type (if present), and provide instant feedback. The system is precisely configured to deliver high-performance results, offering real-time recommendations for medications or treatments based on its findings. By reducing the stress and inconvenience associated with hospital visits for dermatological consultations, this system empowers individuals to identify skin-related issues accurately and make informed decisions about seeking further medical attention from a qualified dermatologist. Powered by image processing using OpenCV, a convolutional neural network (CNN), and machine learning techniques, the system excels in recognizing various skin conditions with high accuracy. It can detect conditions such as nevus, vascular lesions, seborrheic keratosis, basal cell carcinoma, melanoma, pigmented benign keratosis, squamous cell carcinoma, dermatofibroma, and actinic keratosis, while also recommending appropriate remedial health solutions.***

Keywords: Skin Cancer, Machine Learning, CNN.

I. INTRODUCTION

Dermatology is a branch of medicine that focuses on conditions affecting the skin, nails, hair, and the delicate tissue lining of the mouth. Computer vision, a subfield of artificial intelligence (AI), enables devices to extract valuable information from digital photos, videos, and other visual inputs, allowing them to respond with appropriate actions or recommendations. While AI gives machines the ability to reason, computer vision equips them with the ability to see. Operating similarly to human eyesight but with enhanced precision, computer vision applications in healthcare have led to faster and more accurate diagnoses.

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The accuracy of these applications improves as more data is used to train the underlying algorithms.

According to research conducted by Santa Clara Valley Medical Center, a computer-based algorithmic approach can predict blood loss after cesarean births more accurately than traditional methods. Similarly, computer vision algorithms can be trained to identify objects with greater precision than medical professionals and detect patterns that the human eye might miss. Skin conditions pose a significant public health challenge globally and can become hazardous when they progress to invasive stages. Dermatological disorders are a major concern for medical professionals.

People often attempt to treat their skin conditions through natural or home remedies, which, if inappropriate, can lead to adverse effects. Addressing skin conditions promptly is critical as they are easily transmitted from person to person. Despite its importance, dermatological treatment methods often lack technological integration. However, advancements in technology, such as smartphone cameras and computer vision, are beginning to address these issues.

Several healthcare applications have been developed that allow users to store pictures of their skin conditions to monitor changes. However, what makes our artificial dermatologist unique is its ability to detect skin cancer in real time. Convolutional Neural Networks (CNNs) have been employed to classify acne into severity levels ranging from mild to chronic, with studies showing that this approach outperforms experienced physicians in accuracy [1].

Skin cancer can be triggered by various factors, including exposure to harmful UV rays, poor dietary habits, improper drug use, and storing hot food in inappropriate containers [2]. Any new or changing spot on the skin lasting longer than 14 days should be evaluated by a doctor. Although skin cancer often shows no early symptoms, signs may appear at any stage [3]. Some of the common signs of skin cancer include:

A new spot on the skin or changes in the size, shape, or colour of an existing spot. These changes can vary greatly so there is no one way to describe how a skin cancer looks.	A growth with a raised border and central crust or bleeding
A non-healing sore that bleeds or develops a crust	A red- or skin-coloured shiny bump on the top of the skin
A red rough or scaly spot that you can feel	A spot that is itchy or painful
A wart-like growth	A scar-like growth without a well-defined border

Impact of computer vision in healthcare: In significantly helping and reducing the load on human beings and more quickly and efficiently identifying the most terrible content, computer vision has played a vital role when it comes to healthcare. Healthcare is a field for which computer vision is providing significant benefits because 90% of all medical data is imaged-based according to objectivity company the UK. What had to be done by people's eyes looking at MRI or X-rays in past years can now be analyzed by machines in a faster and more accurate way. problems we are facing in the aspect of dermatology is a lack of systems everywhere even at home which can help you any time, secondly, the majority of people feel very lazy to go to the hospital to see a doctor when they are having skin disorders like rashes or hair diseases like dandruff. They always feel and believe that it will surely go away without knowing that it can be a cancerous disease. Had it been there are some systems in everyone's home, I am very sure that whoever scans and sees the problem in his skin or hair will probably visit the hospital for treatment.

II. REVIEW CRITERIA

By studying different research articles that are related to this, several general skin experiments are conducted without an advanced automated method. To identify skin illnesses, researchers have suggested image-processing methods. Some of the most recent works are illustrated in this literature.

A method of skin disease detection using image processing by Nawal Soliman and Ali kofizi al Enezi provided a technique of skin disease detection. They have proposed a system that will be the detecting and classifying of skin disease. The system was able to detect two categories of skin diseases which are melanoma and eczema. The system has an accuracy of 100% [4].

SouraKumarar Patnaik et al. 2018, have given an algorithm under deep learning for identification of skin diseases, The study uses computer vision algorithms to discriminate between several forms of dermatological skin disorders. For feature extraction and learning techniques, they used a variety of deep learning algorithms, including Inception Vs, MobileNet, ResNet, and Xception. They attained an 88% accuracy rate [5].

Mustafa Qays Hatem in 2022 built a technique in MATLAB to recognize skin lesions and categorize them as benign or normal in this study. Classification method is carried out by employing the K-nearest neighbour(KNN) technique to distinguish between normal skin and pathological skin lesions. In classifying skin lesions, the system's accuracy reached 98% [6].

Dure Sameen et al. in 2020 presented a MATLAB cancer detection program using image techniques for production. It tells about cancer existence and it tests the parameters of melamine such as Asymmetry, Boundary, and Colour. They are calculated by texture analysis and edge detection. And they achieved a high accuracy [7].

Kritika Sujay Rao et al. in 2020 also constructed an excellent model based on deep learning to distinguish between healthy skin disease and skin illness, as well as disease categorization into its primary groups. The method aspires for 93% accuracy in autonomous computer-based identification of skin illness to decrease life risks [8].

An application was developed in which if a cancer image is fed into it, it would analyze the image using unique image processing algorithms to determine the existence of skin cancer. They would gather images from users' devices using a camera or system storage and identify skin cancer like melanoma to their closest prediction in the application. It would give a description and symptoms of the condition after successful identification [9].

Skin disease prediction by using a neural network on image analysis by (Prof. Srikant Sanas (Guide) et al. 2021). They employed a computer algorithm called RestNet152V2, which includes a few steps for image processing, picture feature extraction, and data classification that was carried out with the aid of a classifier like an artificial neural network (ANN). To detect skin illnesses, the technique employs feature extraction and a soft-max classifier for convolutional neural networks [10].

And lastly, Skin disease detection using image processing techniques by (Prem J. Patil et al. 2020). In this paper, they proposed a system, the project aims to develop a skin disease diagnosis system inbuilt on a machine learning model to classify the infected images using baa g of feature extraction and develop an android interface application to take images. The designed model was able to classify the infected imam ages with an accuracy of training of 80% whereas the accuracy of testing of 89% [11].

A study makes use of the ISIC public dataset and convolution-based deep neural networks to identify skin cancer. It is continued by stating that cancer diagnosis is a delicate matter that is vulnerable to mistakes if it is not done quickly and correctly. The ability of each machine learning model to identify cancer is constrained. Individual learners are expected to make more correct decisions individually than collectively. In this study, a skin cancer detection ensemble of deep learners has been built using VGG, CapsNet, and ResNet learners. The findings demonstrate that, in terms of sensitivity, accuracy, specificity, F-score, and precision, the choice made jointly by deep learners is superior to the finding of deep learners acting independently [12].

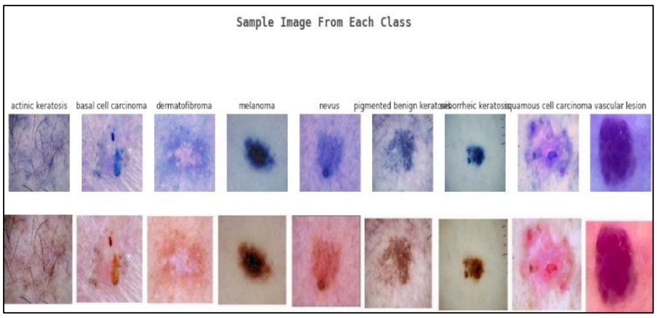
Region-of-Interest based transfer learning assisted framework for skin cancer detection by (Reha Ashraf at el. 2020) [13]. They develop an intelligent Region of Interest (ROI)- based system that uses transfer learning to distinguish between melanoma and nevus malignancy [15]. The ROIs are extracted from the photos using a better version of the k- mean technique [16]. As the system is trained using pictures containing only melanoma cells, the ROI-based technique aids in the identification of discriminative characteristics [17]. For ROI pictures from the DermIS and DermQuest datasets, they also utilise a Convolutional Neural Network based on a transfer learning model with data augmentation [18]. DermIS and DermQuest accuracy results from the proposed system are 97.9% and 97.4%, respectively [19].

Automating the ABCD rule for melanoma detection: A survey by (Abder-Rahman H. Ali et al. 2020), The primary contributions to automating asymmetry, border irregularity, colour variegation, and diameterin the literature are reviewed in this work, with a focus on the various approaches used [14].

III. METHODOLOGY

A doctor can differentiate one form of cancer from other cancers because of the unique look of each type of cancer cell and the categorization of skin cancer can aid a physician in creating a successful treatment strategy. As the number of cancers being observed worldwide rises daily and each disease has a variety of instruments that might occasionally capture photographs, classifying skin cancer images is a crucial challenge for creating classification maps. Nevus, vascular lesion, seborrheic keratosis, basal cell carcinoma, melanoma, pigmented benign keratosis, squamous cell carcinoma, dermatofibroma, and Actinic keratosis are the nine distinct classifications that this method presented a fresh technique for classifying.

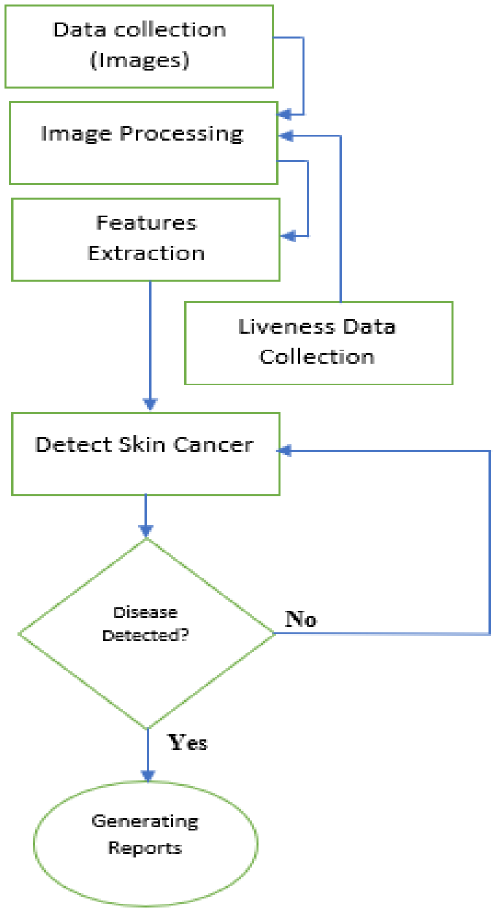
About the Dataset: When training the model, more than 2000 images of different skin diseases were employed. Furthermore, we created a test model with about 500 comparable images. The International Skin Imaging Collaboration (ISIC) produced the images, which depict both benign and malignant skin disorders. The total photographs were arranged based on the category established by ISIC, except for melanomas and moles, whose photos have a slight preponderance. The same number of photos was used to split up each grouping. The dataset consists of all 9 different cancer classes mentioned in the methodology.



[Fig.1: Sample Images of Each Then Cancer]

This method breaks down its work into different stages to provide an efficient framework for classifying cancer images; these stages are crucial for providing higher classification accuracy. Below is a description of these phases.

- *Skin cancer detection:* the system will try and detect among the 9 classes of skin cancer (Nevus, vascular lesion, seborrheic keratosis, basal cell carcinoma, melanoma, pigmented benign keratosis, squamous cell carcinoma, dermatofibroma, and Actinic keratosis) through the images taken or uploaded by the patient. If any skin cancer is detected, then it will move for features



[Fig.2: Architecture]

- Data collection: This is the first step when you run the system. In this step, the system will ask you to upload vivid images of your skin showing the area where exactly the problem is.
- Liveness data collection: This is also a phase where the system collects data through a live video using smartphone cameras, computer cameras, etc. it differs from the first step of data collection because it will capture the affected area in the skin in real-time while in the first step of the data collection you will need to upload the images that are already taken.
- Image processing: Images of the damaged skin are captured during this period utilizing digital devices such as cameras, smartphones, laptops, etc. All of the patient's provided photos will be processed using the system's algorithms, which will determine whether or not each one is healthy and suitable for surgery.
- Features extraction: In this stage, it is necessary to extract the area's characteristics, which might base on color, form/shape, or texture extraction otherwise it will keep trying to detect any disease.
- Classification, and generating final reports: Identifying whether the input picture is healthy or unhealthy is implied by the classification stage. Or it determines that during a real-time video. If an image is found to be diseased then the system will generate a report regarding the type of the disease. After that, the system will give final results and a suggestion about the detected disease like the name of the disease, what caused it, and the actions that you need to

take against it, it may also suggest visiting the hospital and seeing a doctor for further reports.

A. Software and Hardware Prerequisites

Computer with a core i3 or better processor. RAM: - 4GB (Recommended).

320GB Hard Circle (Recommended). Framework: Streamlit and Flask.

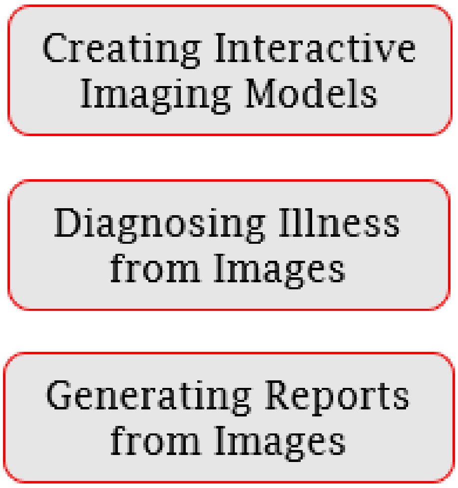
Integrated Development Environment (IDE): - Firstly, there are several IDEs to work with, but we chose and used Google Colab because you can develop and run python code through your browser and it is a great tool for deep learning projects.

It also has a great version that offers access to Google computer resources and needs no setup.

Secondly, we used Visual code studio for writing the front end of the web application which comprises HMML, CSS, and JavaScript languages.

B. Applications of This System in the Area of Dermatology

The applications of this system in the area of dermatology are categorized into three as shown below.



[Fig.3: Applications of This System in the Area of Dermatology]

i. Diagnosing Illness from Images and Creating Interactive Imaging Models: Due to AI's expertly tuned pattern-recognition capabilities, the implementation of this system in dermatology can most likely enable the diagnosis of early signs. This may result in prompt medical attention and ultimately save numerous lives at home. Additionally, it will make it possible for medical practitioners to fully comprehend the patient's problems thanks to the system's output. It will easily help dermatologists in prescribing medicines for the patient without spending much time finding the problems since the system already detected and brought the illness.

ii. Generating Reports from Images: This involves automatic report generation. Based on the information included in the photographs or videos acquired of the patient, the system can provide reports and outputs with accuracy. For dermatologists or other medical professionals, this may save a ton of time because they won't have to spend as much time physically typing down their results after spending time examining photographs and concluding.

IV. RESULTS

The implementation result of this system is shown in fig.4. Initially, the input images are processed, and as well as the images are captured in real time. Then features are extracted using Convolutional Neural Network (CNN), and then the classification of the diseases is performed.

The performance of the different machine learning algorithms is evaluated on the following metrics;

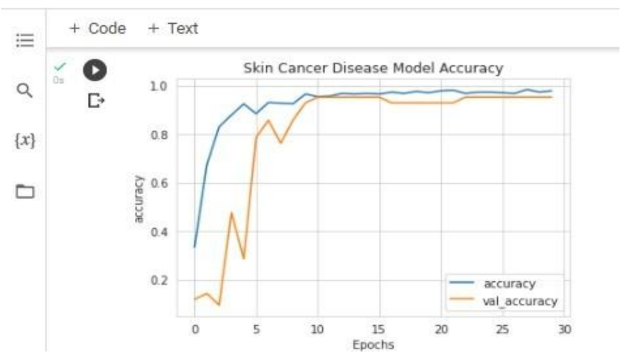
i. Accuracy: - it is the ratio of correctly predicted observations to all observations, which is the most sensible performance statistic.
ii. Precision: - A measure of precision is the proportion of accurately anticipated positive observations to all expected positive observations.
iii. Recall (Sensitivity): - The ratio of accurately anticipated positive observations to all of the actual class observations is known as recall.
iv. F1 Score: - This is calculated by averaging the accuracy and recall measurements. Therefore, both false positives and false negatives are included while calculating this score.

	precision	recall	f1-score	support
0	0.67	1.00	0.80	2
1	1.00	0.75	0.86	8
2	1.00	0.90	0.95	10
3	1.00	1.00	1.00	6
4	1.00	1.00	1.00	2
5	0.75	1.00	0.86	3
6	1.00	0.83	0.91	6
7	0.67	1.00	0.80	4
8	1.00	1.00	1.00	5
accuracy			0.91	46
macro avg	0.90	0.94	0.91	46
weighted avg	0.94	0.91	0.92	46

[Fig.4: Performance]

When the training of the model and evaluating its performance is done, the system had an accuracy, precision, recall, and f1 score of 0.91, 0.90, 0.94, and 0.91 respectively. To calculate this in percentage, multiply each by 100. Then the results would be 91% accuracy, 90% precision, 94% recall, and 91% f1 score. The image in fig.4 shows the same.

So, the system has an accuracy of 91% as it is shown in fig.4 and fig.5.



[Fig.5: Graphical Accuracy of the System]

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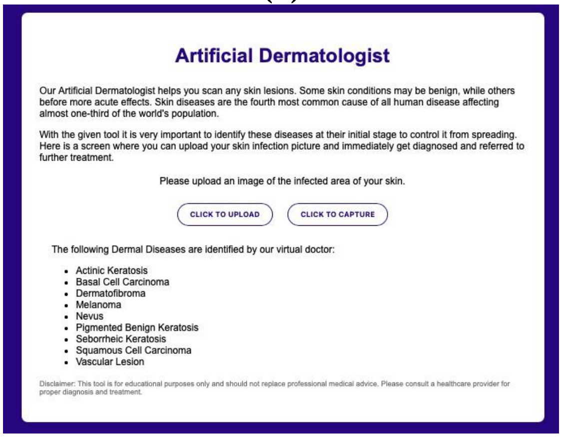
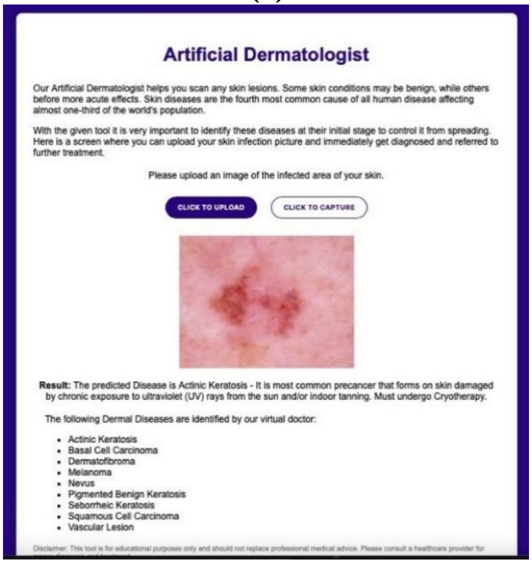
How It Work: Our Artificial Dermatologist works in two different ways:

1. Uploading Images: In this stage after accessing the system, you will need to click on the "CLICK TO UPLOAD" button so that you can upload the image of the infected area of your skin. After that, you will notice a preview of the image you uploaded then click on "CLICK TO SEE THE RESULT" to see the problem with your skin. All the steps are shown below in fig.6.

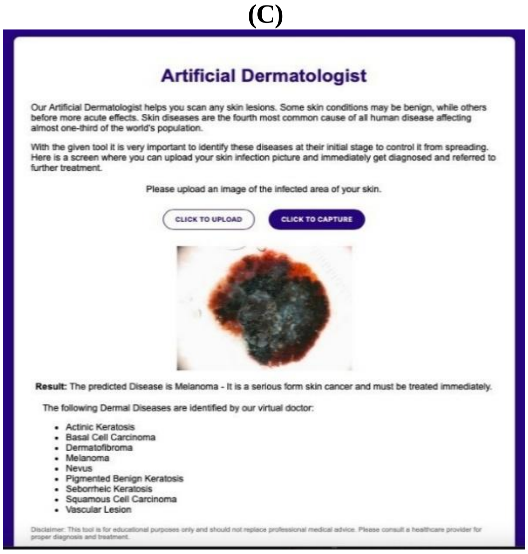
(A)



(B)



(C)

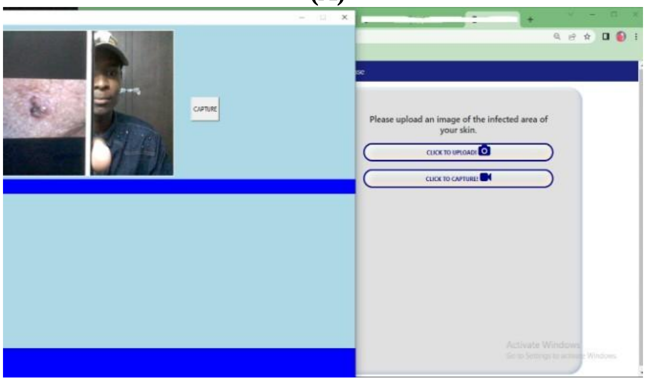


[Fig.6: These Pictures Show the Steps and Results of the First Part of the System for Some Skin Cancer]

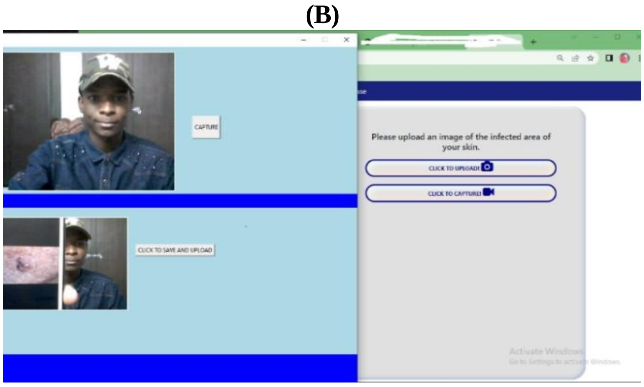
2. Capturing Images in Real-Time: This is the second part of the system where you can capture an image of the infected area of your skin in real-time by clicking on "CLICK TO CAPTURE". It will then access your camera and show you where you can capture the image and save it. After you clicked on "CLICK TO SAVE AND UPLOAD" a preview of the image you captured will pop up on the screen and you will need to click on the "CLICK TO SEE THE RESULT" button to see the result as it says. All are shown in fig.7.

Note: Make sure you use a vivid camera to avoid errors in results.

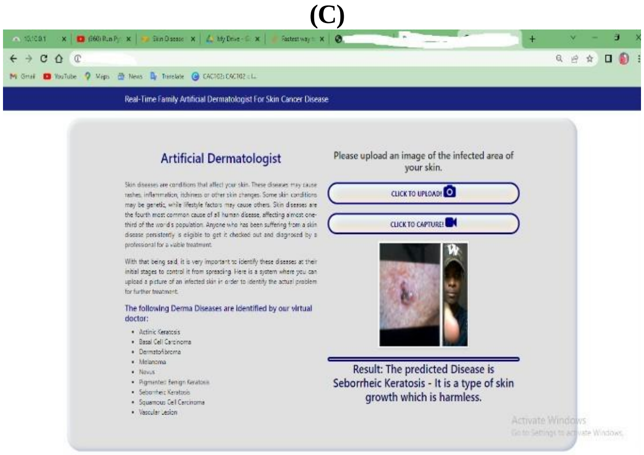
(A)



(B)



(C)



[Fig.7: Shows the Results of the Second Part of the System]

V. CONCLUSION

This system has overcome the issues related to human skin by helping patients in their homes or everywhere to detect the complications associated with their skin by examining the symptoms through the system. This system could be improved and become better in the future through the development of disease detection algorithms and building a standard machine with the use of In the Internet of Things (IoT) that can perform all the tasks given to the system and even more. A more extensive feature set would also prevent the chance of tricking the machine through the alteration of skin cancer disease detection features.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been sponsored or funded by any organization or agency. The independence of this research is a crucial factor in affirming its impartiality, as it has been conducted without any external sway.
- **Ethical Approval and Consent to Participate:** The data provided in this article is exempt from the requirement for ethical approval or participant consent.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

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