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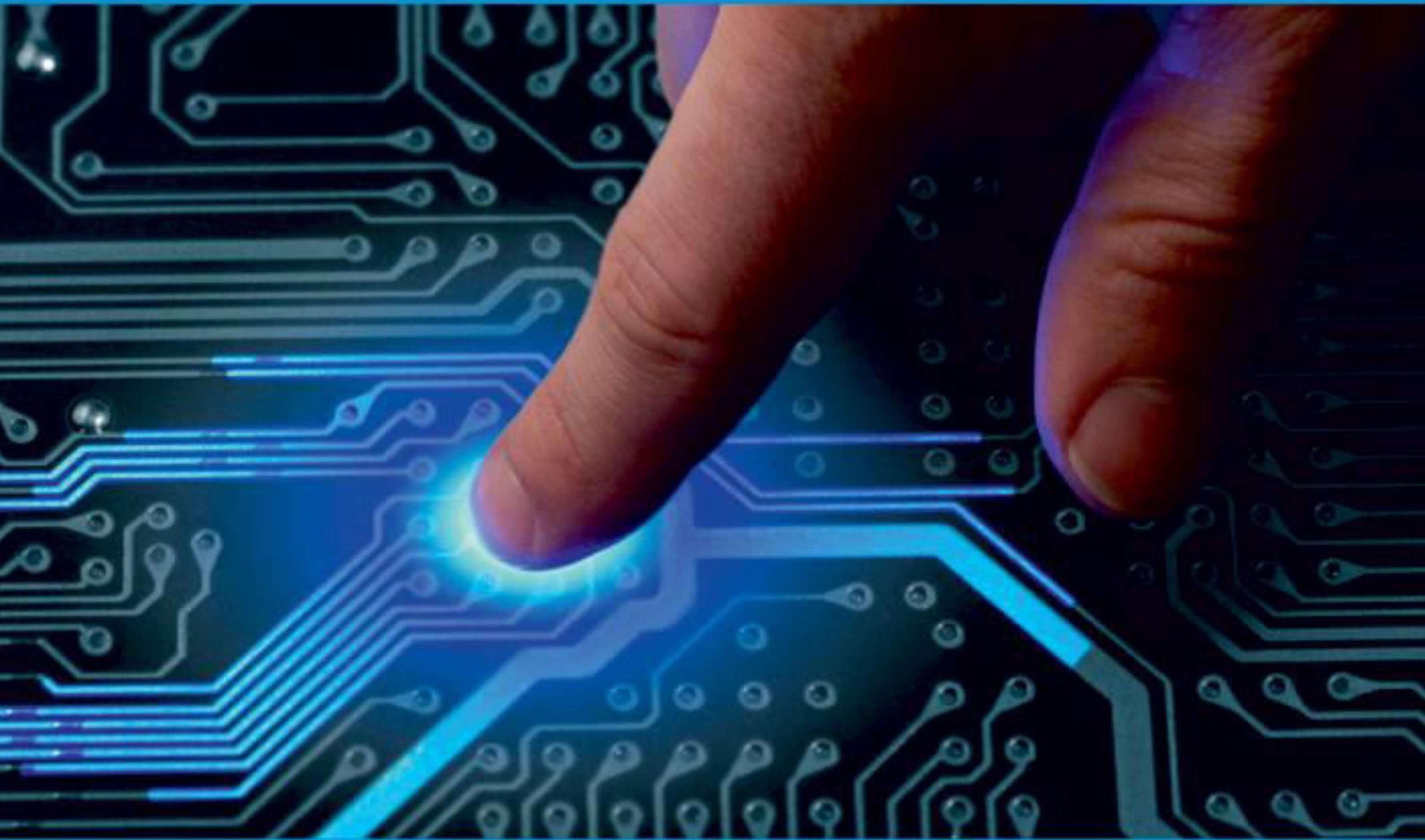

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Forecasting and Categorizing Dermatological Conditions with Deep Learning Techniques

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ABSTRACT: Dermatological problems are highly prevalent worldwide. The progress in lasers and photonics-based medical technology has enabled the expedited and precise diagnosis of skin diseases. However, the expense associated with this type of diagnosis remains constrained and exceedingly costly. Image processing techniques are utilised to develop an automated screening system for dermatology in its early stages. A computer-aided approach for diagnosing skin illnesses is presented to offer a more objective and dependable answer to this issue. Expert medical professionals and advanced instruments are required to diagnose various skin disorders, as the images of skin diseases lack sufficient visual resolution. The suggested framework incorporates deep learning techniques, including the use of Convolutional Neural Network (CNN) architecture. A dataset containing photos of seven disorders has been collected for the purpose of classifying skin diseases. These disorders encompass conditions such as Melanoma, Nevus, and Seborrhoeic Keratosis. The dataset was expanded by incorporating photos depicting lacerations and thermal injuries, which were predominantly categorised as dermatological conditions by the majority of the preexisting systems. This research presents a skin disease diagnosis methodology that utilises image processing and Deep learning algorithms. Deep Learning algorithms have diminished the necessity for human labour, specifically in tasks involving manual feature extraction and data reconstruction for classification purposes.

KEYWORDS: Convolution Neural Network, Dermatological, Automated Screening, Deep learning techniques.

I. INTRODUCTION

The skin, being the largest organ in the human body, can exhibit a multitude of potential disorders, encompassing around 1500 unique skin diseases. Our understanding of the symptoms of most of these disorders is limited, but it is expanding rapidly. This poses a problem for dermatologists in diagnosing them. Currently, advancements in technology have significantly impacted various aspects of our daily lives, including the field of medicine. Numerous medical systems have been created to assist both patients and doctors in various ways, ranging from streamlining the registration process to utilising technologies for disease diagnosis.

The skin, comprising the epidermis, subcutaneous tissues, blood vessels, lymphatic vessels, nerves, and muscles, is the biggest organ in the human body. The application of liquid to the skin can enhance the skin barrier function by preventing lipid degradation in the epidermis. Skin illnesses can occur due to fungal growth on the skin, presence of bacteria, allergic reactions, microbial impact on skin texture, or pigment production [1]. Dermatological conditions are characterised by their chronic nature and, in some cases, can progress into malignancies. In order to reduce the occurrence and spread of skin diseases, prompt treatment is necessary [2]. There is currently a high demand for research on methods to detect the impacts of various skin diseases using imaging technology. Various dermatological conditions manifest symptoms that can be challenging to manage in patients, as they can persist for several months before receiving a proper diagnosis. Previous research in computer-aided categorization for dermatology has been limited in its capacity to generalise to medical experts, mostly due to a lack of appropriate data and a narrow focus on standardised activities, such as dermoscopy, which involves examining the skin using surface microscopy. Computer-aided diagnosis can effectively and dependably diagnose skin disorders to choose appropriate medicine based on patients' symptoms [3]. This

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study introduces a resilient mechanism that may precisely detect skin illnesses using supervisory methods that reduce the expenses associated with diagnosis.

The prevalence of skin disorders manifests in various ways, along with a scarcity and uneven distribution of competent dermatologists. Consequently, there is a pressing demand for data-driven diagnosis to ensure quick and precise identification of these conditions. The progress in lasers and photonics-based medical technologies has enabled the rapid and precise diagnosis of skin diseases. Nevertheless, the expense associated with this type of diagnosis remains restricted and costly. Deep learning models [4–7] are highly effective in classifying images and data. The healthcare industry has seen an increased need for accurate identification of abnormalities and classification of diseases using diagnostic tools such as X-ray, Magnetic Resonance Imaging (MRI), and Computer Tomography (CT). Accurate categorization of the disease will aid in delivering more effective treatment to patients. Deep learning models has the ability to autonomously recognise the characteristics of the input data, enabling them to effectively address significant issues. Furthermore, these models are highly flexible and can easily adapt to changes in the problem at hand. Deep learning methods utilise inferred data to detect and analyse features in previously unseen data patterns, even with less powerful computer models, leading to significant efficiency gains. The authors were encouraged to consider a deep learning model for categorising the category of skin diseases based on the image of the affected region in their proposed work.

Dermatological illnesses have the highest prevalence globally. Although it is common, diagnosing it is extremely difficult and necessitates substantial expertise in the field. According to a survey, approximately 24% of the population seek advice from their general practitioner (GP) for a skin issue within a one-year timeframe. The college level education in dermatology is variable and often limited, indicating that trainees should evaluate their current abilities and knowledge in this specific field. Currently, approximately 90% of skin problems are exclusively treated by Primary Care.

This implies that the majority of skin disease problems can be resolved if early treatment is performed. Patients can experience a substantial influence on their quality of life due to skin diseases [6]. The prevalence of dermatological conditions is on the rise, and the prognosis greatly hinges on timely detection. General practitioners have a crucial role in promptly identifying and diagnosing skin conditions [1].

Various initiatives have been undertaken to introduce traditional medicine in different regions, particularly in technologically underdeveloped countries. However, these efforts have encountered obstacles such as the high expenses associated with medical instruments and equipment, as well as a shortage of medical expertise. Skin diseases commonly arise from a combination of environmental factors and various other reasons. Most communities worldwide still lack widely available essential instruments for early identification of many diseases. The proposed research presents a methodology for identifying different types of these disorders. The user provides an image of a skin disease, which is then processed by the system. The system utilises a CNN algorithm to extract features from the image and employs a softmax image classifier to diagnose the ailment. In the absence of any detected illness, the system generates a negative outcome. This research proposes a new method for detecting and classifying dermoscopy images using Convolutional Neural Networks (CNN).Diagnostic classifier for identifying illnesses. In the absence of any detected ailment, the system yields a negative outcome. This research presents a new method for detecting and classifying dermoscopy images using a Convolutional Neural Network (CNN).

II. LITERATURE REVIEW

Vinayshekhar Bannihatti Kumar, Sujay S Kumar and Varun Saboo,2016[1] has provided an approach to detect 6 different skin diseases using smartphones, they have implemented dual stage approach combines machine learning and computer vision. The computer vision consists of two stages in the first stage eight pre-processing techniques were implemented in order to extract features of the image namely converting to grey scale image, sharpening filter, median filter, smooth filter, binary mask, RGB extraction, histogram and sobel operator, the extracted features are used as input for training two different models in the second stage, these models are Maximum Entropy model and Feedforward Artificial Neural Network with two hidden layers and Softmax output layer that learned using Backpropagation learning algorithm, this stage was developed for users that couldn't access the histopathological attributes.

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Pravin S. Ambad1, A. S. Shirsat, 2016[2] have develop an Image analysis system to detects skin diseases, they develop a system to be used for early detection and prevention of the skin diseases and they target 3 main diseases skin cancer, psoriasis and dermatophilosis, the disease diagnosis and classification is built on statistical parameter analysis. Statistical parameters include: Entropy, Texture index, Standard deviation, Correlation, the user of the system will able to take images of different moles or skin patches. Then the system will analyzeand process the image and classifies the image to normal, melanoma, psoriasis or dermo case based extracting the image features.an alert will be provided to the user to seek medical help if the mole belongs to the atypical or melanoma category, the input images firstly passed througha median filter to remove a remove the noise, then apply the image enhancement and the statistical analysis techniques, then two-level classifier is used the first level is to specify if theimage is either normal or abnormal and the second level is to classify into specified category: Melanoma, Psoriasis or dermo, the system is classify the images with accuracy 90%.
Deep learning [23], a subset of machine learning [24], has been increasingly used in the field of skin disease classification in recent years. This is due to its ability to automatically extract features [25], and patterns from large and complex datasets, such as images of skin lesions. In this section, we will review the current state-of-the-art in skin disease classification over the last few years using DL techniques. We will examine the various techniques that have been proposed in these studies, such as TL and DNNs, to compare these methods with our proposed classifier in this manuscript.

A study presented in [26], explores the use of DL techniques for the classification of skin lesions on imbalanced small datasets. The authors propose the use of a single model of DL and evaluate its performance in comparison to traditional machine learning methods and human experts. They found that this approach has the potential to improve diagnostic accuracy and reduce the time required for diagnosis, even when working with small, imbalanced datasets. However, the use of DL on imbalanced small datasets also poses challenges such as overfitting and a lack of robustness in the classifier. The authors also suggest potential directions for future research in this field to overcome these challenges, such as the development of more advanced DL architectures and techniques and the integration of additional clinical data. The best proposed model in this study, namely RegNetY-3.2GDrop, achieved a balanced accuracy value of 85.8% using the ISIC 2018 dataset.

A scientific study featured in [27], presents a new method for skin lesion classification using DL techniques. The proposed method, called SSD-KD, is a self-supervised, diverse knowledge distillation method that uses a lightweight model to classify skin lesions from thermoscopic images. The authors evaluate the performance of this method and show that it can achieve an accuracy of 84.6% and generalization capability even when working with a small dataset. The authors also point out that this approach is an efficient method for skin lesion classification, especially when there is a lack of labeled data. On the other hand, one of the limitations of this study is that it achieves a low level of accuracy.

A scholarly article published in [28], introduces a new technique for diagnosing malignant melanoma using DL techniques. The proposed method, called 2-HDCNN, is a twotier hybrid dual convolutional neural network feature fusion approach that fuses multiple features from different sources to improve diagnostic accuracy. The authors of the article have evaluated the performance of this method and have found that it is able to achieve high accuracy and generalization capability on the task of malignant melanoma diagnosis, with an accuracy of 92.15%. This means that the method can accurately diagnose malignant melanoma in a high percentage of cases.

A paper appearing in [29], provides a new method for extracting and classifying skin lesion features using DL techniques. The proposed method uses regularization techniques to improve the accuracy and robustness of the model. It also uses layer-wise weight norm-based feature extraction to extract informative features from the skin lesion images. The authors evaluate the performance of this method on several datasets and show that it can achieve an accuracy of 94.42% on the ISIC 2018 dataset, 91.73% accuracy on the ISIC 2019 dataset, and 93% accuracy when evaluated on the combined dataset.

A work documented in [30], discusses a novel approach for skin lesion classification using DL techniques. The proposed method, called End-to-End Decoupled Training (E2EDT), is designed to handle the long-tailed distribution problem, which is a common issue in the skin lesion classification task. E2EDT is a robust DL method that decouples the training process into two stages: pre-training and fine-tuning. The authors evaluate the performance of this method using the ISIC 2018 dataset and show that it can achieve a balanced accuracy of 87%.

Statement of the Problem

There is a growing prevalence of skin problems in contemporary society. Several of these diseases can be fatal, especially if they are not detected and treated promptly during their progression. Typically, clinicians possess a strong intuition regarding the nature of the problem and the optimal path of treatment. They should initiate a quest for additional evidence to validate their theory, and if it proves to be false, they should consider the possibility that they have disregarded other diagnoses. Just like any search initiated by a user's provided terms, every human search is subject to bias, and physicians are not exempt from this influence. Furthermore, commencing with symptoms and retracing steps may result in the physician exhibiting a bias towards a particular diagnosis, disregarding the possibility that an unrecognised or underestimated symptom is actually the underlying cause of the patient's condition. Consequently, the patient may be incorrectly diagnosed.

In areas, particularly in Low and Middle Income Countries, where there may be a lack of access to medical specialists who are inexperienced or unable to meet urgent medical needs, relying on them for the analysis of medical image identification, such as dermatological-related cases, is a significant difficulty. We require a more effective and manageable solution promptly to minimise the influence of human biases and dependencies.

Existing System

Prior research in the domain of skin disease classification has predominantly concentrated on employing deep learning methodologies. Although these approaches have demonstrated promising outcomes, there are notable deficiencies that require additional investigation. A significant deficiency is in the insufficient investigation of multi-modal and multi-task deep neural networks for improved skin disease classification. Prior research has primarily concentrated on analysing data from a single source or developing models for a single objective, disregarding the advantages of combining several types of data or utilising numerous interconnected tasks concurrently. Our research intends to fill this gap by using a transfer learning strategy within the framework of multi-modal and multi-task deep neural networks. This will allow for a more comprehensive and precise classification of skin diseases. This approach has the potential to utilise the additional information from several types of data, such as pictures, genetic data, and patient history, in order to enhance the overall accuracy of categorization. Moreover, incorporating several interconnected activities, such as evaluating the seriousness of a condition or providing treatment suggestions, can significantly augment the diagnostic capabilities of the system. Our research aims to close the gap between different modes and tasks in deep neural networks, hence enhancing skin disease categorization algorithms. This has practical implications for improving diagnostic accuracy and patient care. Prior models of automatic skin identification had a maximum accuracy of 75% and were capable of detecting only six skin disorders. By utilising this model, we may attain a higher degree of precision and predict a greater number of diseases compared to what was previously feasible. This information provides details on the specific illness and the locations of the nearest physicians.

Proposed Solution

In the field of skin disease classification, previous studies have primarily focused on using deep learning techniques. While these approaches have shown promising results, there are significant gaps that necessitate further research. One notable gap is the limited exploration of multi-modal and multi-task deep neural networks for enhanced skin disease classification. Existing studies have predominantly focused on single-modal data or single-task models, neglecting the potential benefits of integrating diverse data modalities or leveraging multiple related tasks simultaneously. By addressing this gap, our research aims to develop a transfer learning approach in the context of multi-modal and multi-task deep neural networks, enabling more comprehensive and accurate skin disease classification. This approach holds

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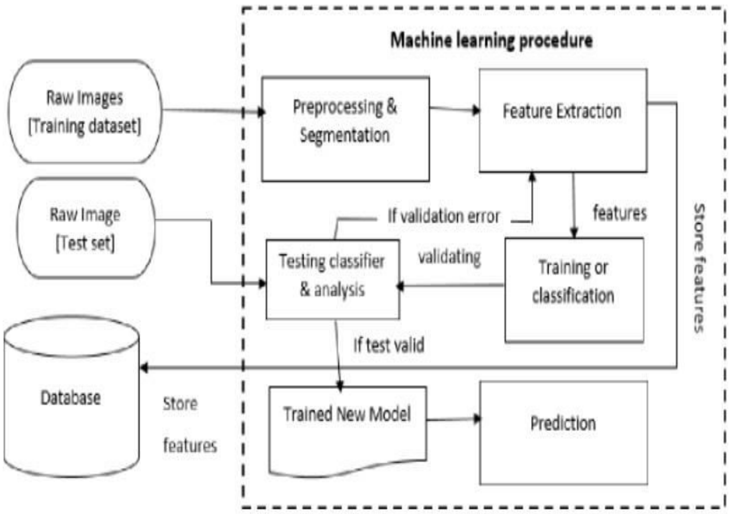
the potential to leverage the complementary information from various data modalities, such as images, genetic data, and patient history, to improve the overall classification performance. Additionally, the inclusion of multiple related tasks, such as disease severity assessment or treatment recommendation, can further enhance the diagnostic capabilities of the system. By bridging this gap and exploring the potential of multi-modal and multi-task deep neural networks, our research contributes to the advancement of skin disease classification techniques and has practical implications for improving diagnostic accuracy and patient care.

III. SYSTEM DESIGN

System Architecture



Methodology Presented

Figure below shows the proposed methodology for skin disease identification.

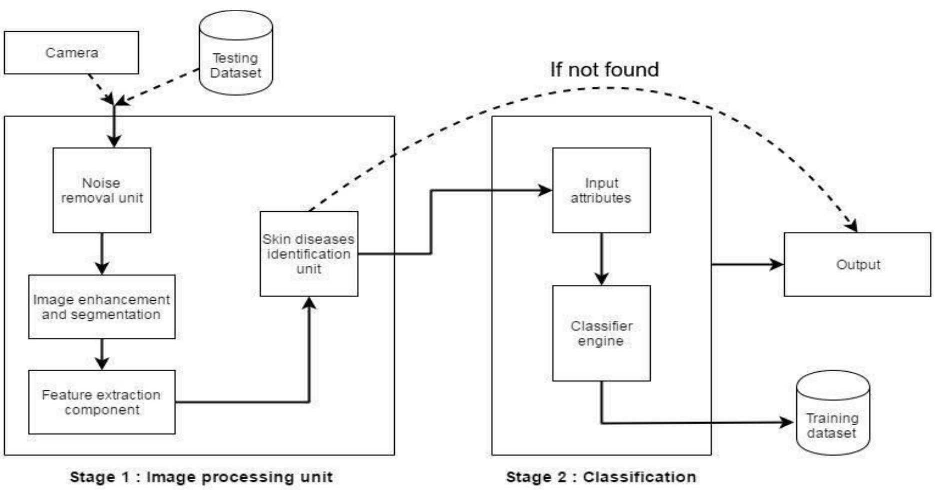


Figure : Methodology Diagram

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The system can be broadly categorized into following major phases:

- Image Acquisition: A camera or a device that keeps photos locally are used to capture the photographs. When it comes to images, no matter where they originate from, they must be clear and correct. High-quality images are required for this.

- Noise, such hair and skin colours, is removed from the picture in this stage to ensure that the analysis is not hampered. It is possible that the picture that is being fed into the algorithm is not the correct size. It's crucial that the algorithm's size requirements be met.

- It's an area to store photos of training and test data: Training data is required for supervised learning, which is the case here. The testing dataset is comprised of the photos captured throughout the acquisition process[2].

- A classification system for identifying the specific kind of skin illness. The last layer of the network, the Softmax classifier, is utilised in this situation to determine the true likelihood of each label being assigned. The architecture consists of two components. Processing and grouping units for digital photos. Noise and undesirable skin portions may be removed by using an image processing equipment. In order to distinguish it from regular skin, the picture will be broken up into many parts. Finally, the image's characteristics will be analysed to determine whether or not the skin is diseased.

- Noise removal unit: Removes blemishes and stray hairs from the image.

- By enhancing the image and separating it into distinct pieces, this helps the damaged region to stand out from the rest of the skin[4].

- Finding the characteristics is an essential first step in every classification challenge. Features are critical for both teaching and assessment. Information included in this feature will help researchers determine what ailment the picture depicts[4].

- It is the job of the Skin Disease Identification Unit to determine whether the skin is malignant or not.

- The image's significant qualities, such as asymmetry, border, colour, diameter, evolution, and so on, are now passed on to the classifier component of the algorithm, which is called Part II[6].

- Pictures are assigned to one of many pre-defined disorders via an image classifier (here softmax classifier is used) [5,6].

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IV. RESULTS AND DISCUSSION

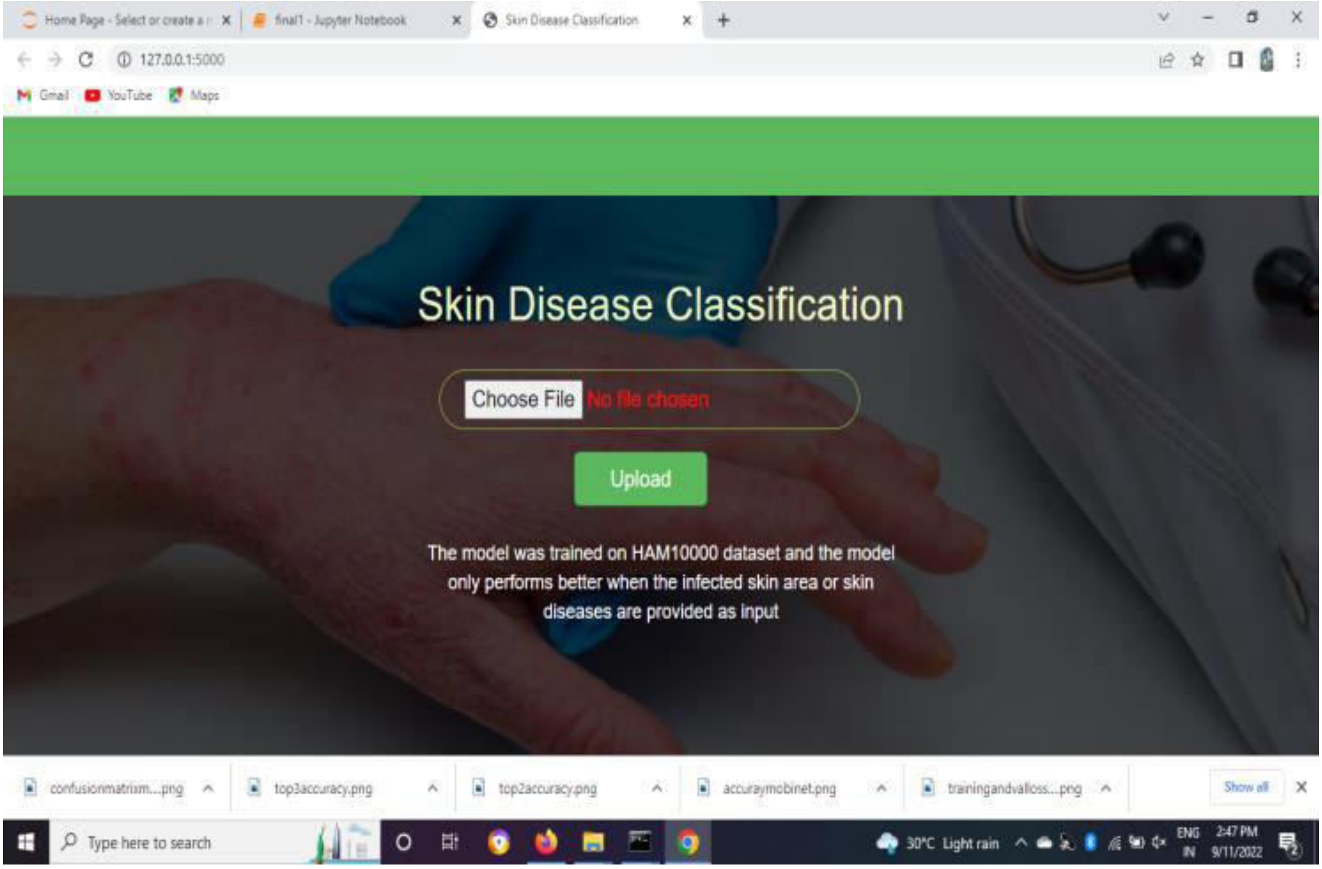

Fig : Home Page

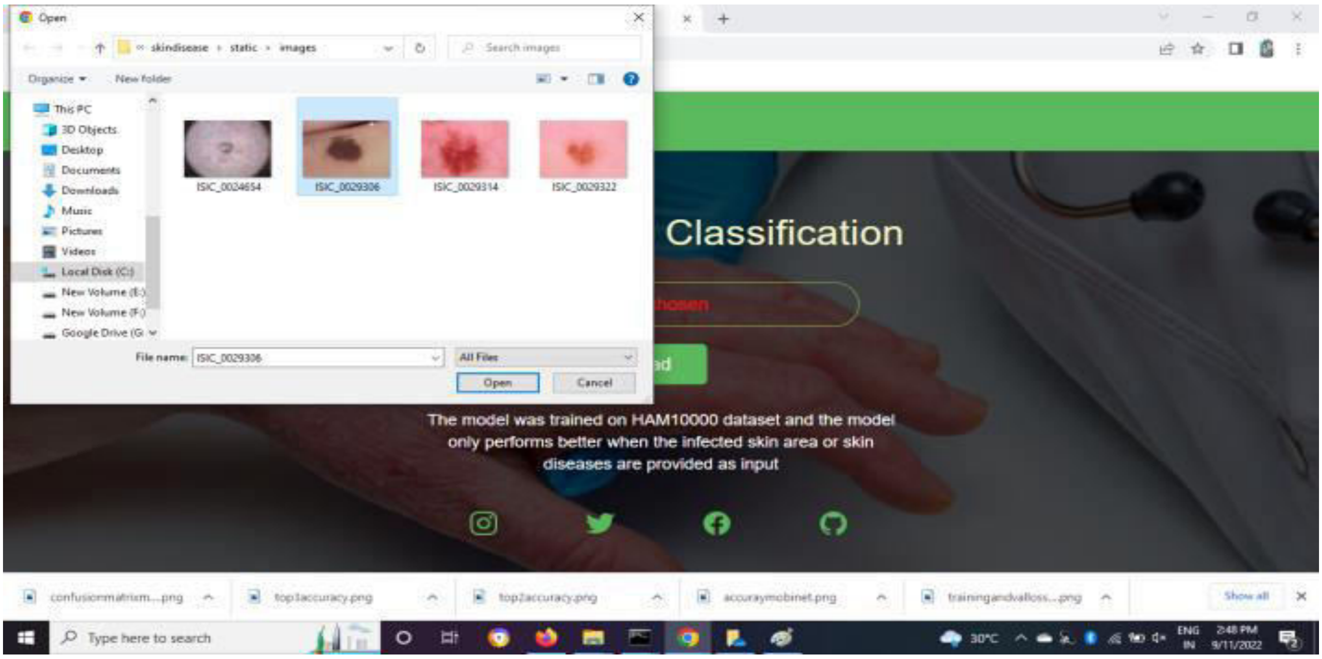

Fig: Input Image

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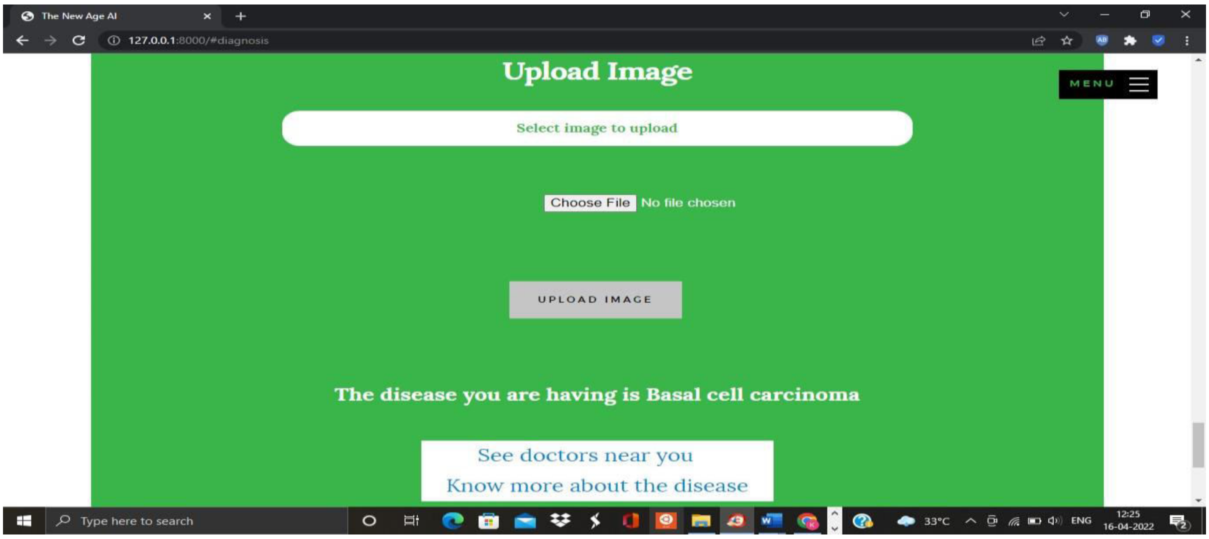

Fig: Result Page

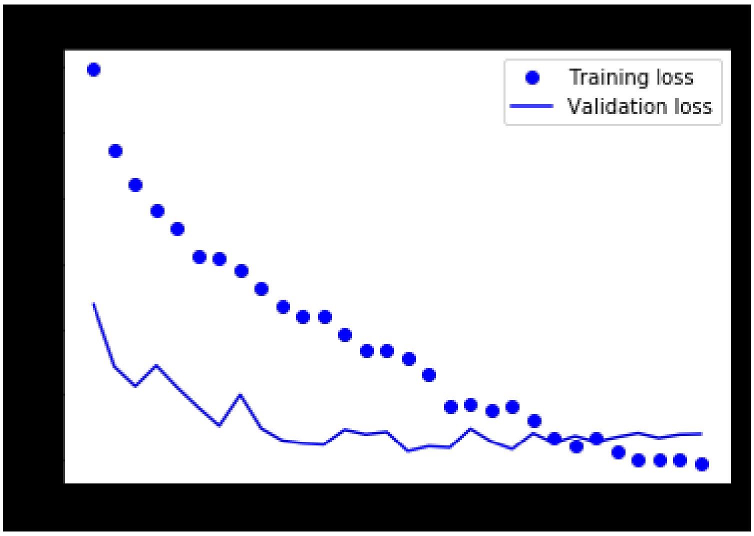

Fig : tranning and validation loss using proposed system

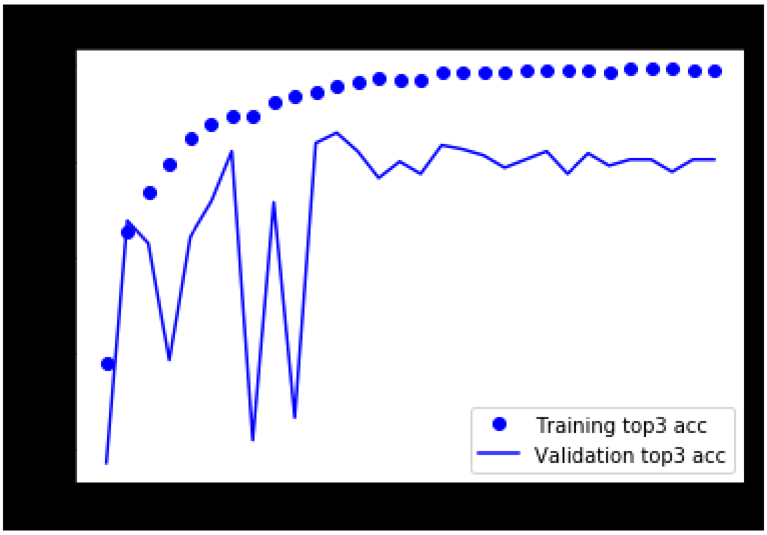

Fig :tranning and validation accuracy using top 3

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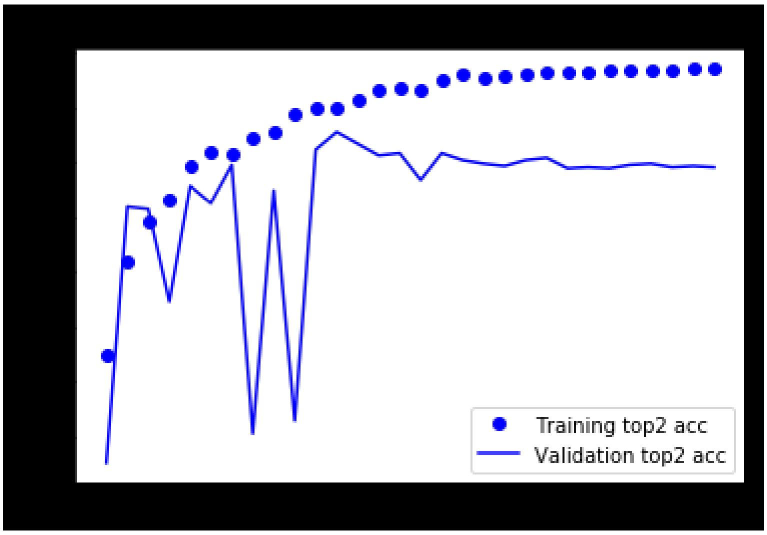

Fig : tranning and validation accuracy using top 2

V. CONCLUSION

This proposed system can be utilised to get knowledge on the categorization of skin problems and to identify different skin conditions. Medical technology has made considerable advancements in recent years, enabling faster and more efficient diagnosis of skin conditions. Nevertheless, the expense associated with these tests remains excessively high and limited. Based on the literature study, the current strategy lacks accuracy and effectiveness in predicting the number of illnesses. Therefore, we have formulated a plan to create an automated system that utilises advanced machine learning techniques to more accurately identify and classify skin diseases.

VI. FUTURE WORK

To enhance the model, it should possess the ability to self-correct and adapt based on its own mistakes and novel encounters. The training process of the model is considerably streamlined, resulting in a notable reduction in necessary effort. Prior to use this model for evaluating the influence of the retrieved attributes for each approach, several necessary actions must be completed. Notwithstanding the substantial volume of data, the researchers advise that forthcoming studies prioritise actions centred upon extracting features based on biomarkers. In addition, biomarkers can be utilised to diagnose an individual's sickness by examining genomic, protein sequence, and pathology data. Utilising a user-friendly smart device application that can showcase alerts and facilitate communication between patients and physicians, while transmitting physiological and biological data across health networks, is a commendable suggestion. This will guarantee the secure transfer of data.

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