A Study on Performance Of Pretrained Model and Customized CNN on Skin Disease Using Deep Learning

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***Abstract*— Accurately identifying skin conditions is essential for providing appropriate medical therapy. Skin disorders can be difficult to diagnose since they frequently exhibit minor patterns and variations. This study examines the use of pre-made models and custom models in the prediction of skin disorders. Pretrained models like Inception-V3 and VGG-16 incorporate knowledge from more broad picture problems through transfer learning. Because customized CNN layers are made to particularly adapt to the unique characteristics of skin images, they offer a personalized approach. We use the HAM10000 dataset, which includes a range of dermatoscopic images, to train and evaluate both methods. The primary goal of the study is to improve skin illness prediction and interpretability. In this work, we aim to advance automated dermatological diagnosis and medical picture analysis by comparing pretrained models with customized CNNs.**

Keywords: Skin Disease, Deep Learning, Pretrained Models, Customized CNN Layers, Transfer Learning

I. INTRODUCTION

Our skin can get sick too just like human catch cold .There are lots of different skin problems that can be very harsh and.sometime no to harsh .It is important to take care of skin and if something happened or does not seem right get help from doctor .After All if Keeping our skin healthy means keeping ourselves healthy too. Skin illnesses are type of problems that can affect to our skin .In this so many diseases and germs get into an action like infection .In infection when germs get in contact with skin the infection occurred, Autoimmune diseases in that diseases body fight our skin , inflammatory conditions in that skin gets swollen and irritating issues and hereditary anomalies in their when skin problems run in the family .So it's important to take care of our skin and get help if something seems off.

The World Health Organization (WHO) has done a lots of research regarding skin problem to find out how common the skin problem ,how much suffering occurs to humans, and how many deaths are caused by different skin problems .By understanding all these skin diseases issues they can work on problems to prevent and treat them to keep people healthy. The WHO did a study called Global Burden of Skin Disorders .In that study they found out that skin related problems cause high value problems on people and healthcare systems around all over the world .This shows how important it is to find out any problem related to skin and treat them as fast as possible. Skin cancer like Melanoma, basal cell carcinoma, and Squamous cell carcinoma are becoming more common worldwide. It happens when your skin gets contact with ultraviolet light, mostly (UV) rays come from the sun, that's why it's important to protect from sun exposure by taking precautions. It's very important to catch skin cancer early because if it becomes too late then it is difficult to prevent it fast.

Even while we've made progress in understanding and treating skin illnesses, we still have certain issues to address. These obstacles make it more difficult to identify strategies to assist persons with skin disorders. So, while we are making progress, there are still barriers to improving treatments . Insufficient public knowledge, restricted access to dermatological care, and the intricacy of certain skin problems all lead to delayed diagnosis and insufficient treatment. In addition, environmental factors combined with the rising worldwide incidence of several skin diseases present continuous difficulties to healthcare systems

II. LITERATURE SURVEY

In 2021 a study was done by Viswanatha Reddy Allu Gunti Melanoma, [1] a potentially lethal skin disease, results from uncontrolled melanocyte growth. Its incidence is at record highs in Australia and New Zealand, with a notable impact on white New Zealanders. Detecting melanoma early is crucial, and this research proposes a deep learning technique to distinguish lesion types (Maligna, superficial spreading, nodular). Using a Convolutional Neural Network (CNN) classifier with data from dermnetnz.org, the model outperforms existing methods in diagnostic accuracy. Early identification aids in prompt isolation and treatment. This innovation holds promise for improving melanoma diagnosis, critical for enhancing patient outcomes.

In 2019 a research was done by Nawal Soliman AL KolifiAL Enezi [2] Skin diseases, prevalent in Saudi Arabia due to deserts and hot climates, pose a significant health concern. This research introduces a cost-effective image processing method for rapid and accurate skin disease detection. Utilizing digital images of affected skin areas, the approach employs image analysis, resizing, and a pretrained convolutional neural network for feature extraction. Classification is achieved through Multiclass SVM, providing results on disease type, spread, and severity. The system achieves a remarkable 100% accuracy in detecting three distinct skin diseases. This simple and efficient approach demonstrates the potential of image processing techniques in automating dermatological screening, especially in regions with high skin disease incidence.

In 2019 a research was done by P. Nagaraj; V. Muneeswaran; K. Jaya Krishna; K. Yerriswamy Reddy J. Rock Morries; G. Pavan Kumar [3] In the growing world people face lots of problems related to skin disorders and some people even do not afford it because of the high price tag. Chickenpox, impetigo, infectious erythema, scabies, and skin warts that can cause lots of pain and they do not get easily relief from this pain it takes lots of time to get out from this .They can cause itching ,pain and sometimes even spread to other people .The one of the application of Convolutional Neural Network is image processing
This application helps them to find out very precise results related to skin problems by submitting the photo of the affected area of the skin to the process of Convolutional Neural Network .

In Dec 2019 a research was done by Rola EL SALEH; Sambit BAKHSHI; Amine NAIT-ALI [4] in advancement of world computers and AI programs also advanced when it comes to recognizing any issues related to people’s skin on their faces these technologies or programs analyze image of skin and provide information about various conditions. In this paper, we suggest a way to automatically detect skin diseases on the face using a special type of computer program called a pre-trained deep convolutional neural network (CNN). This means we've trained a computer program to recognize different skin conditions by showing lots of pictures of skin with those conditions. Then, when you give it a new picture of someone's face, it can use what it's learned to tell if there's a skin disease present. This could help doctors diagnose skin problems more quickly and accurately. To start, we enhance the images by using some techniques to make them bigger. This helps us increase the number of pictures we have in our database. These pictures come from various places and are adjusted to fit our computer program. Then, we use these images to teach and test our model. We'll demonstrate that our program can correctly spot eight different facial skin diseases, as well as identify normal skin and recognize when there's no face in the picture. Overall, our model can do this with an accuracy rate of 88%, which means it's pretty good at its job!

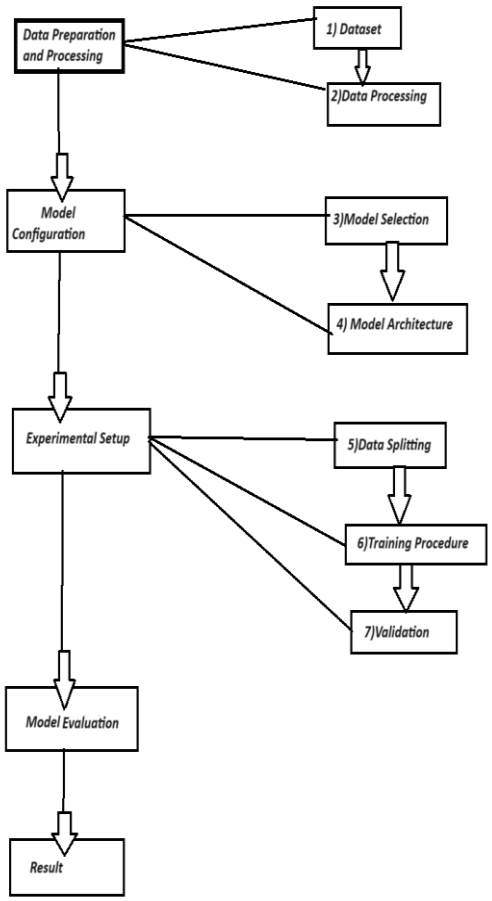
In Feb 2019 research was done by Nazia Hameed; Antesar M. Shabut;
M. A. Hossain [5] Around the world, skin diseases rank as the fourth most common reason people suffer from illness or discomfort that doesn't result in death. This means that skin problems affect a lot of people and can cause significant challenges in their lives, even though they're not typically life-threatening. Skin diseases are a big problem in both rich and poor countries. This shows that it's really important to focus on preventing these skin issues from happening in the first place. Whether someone lives in a wealthy country or a less wealthy one, everyone can benefit from efforts to keep skin problems at bay. So, it's crucial to put a lot of weight on stopping skin diseases before they even start. This research introduces a smart way to diagnose different types of skin lesions.
They've come up with a plan that combines two techniques: a deep convolutional neural network and something called error-correcting output code support vector machine (SVM). Essentially, they've created a method that uses both advanced computer learning and a system that corrects mistakes to identify skin problems. This type of method is generally designed to different types of skin lesion images into five categories : healthy skin, acne, eczema, benign(not harmful),or melanoma(type of skin cancer).In this method computer program are trained in this way that recognize and categories different skin issues, show that doctors can easily diagnose and helpful for doctors that treat them precisely. Some models are already trained to understand images that help to identify different features in the pictures
The researchers conducted an experiment and used that type of model called Alex Net using 9,144 images collected from different places. After that experiment for the classification of images, they used a method called ECOC SVM to divide the images into different groups. This approach achieved an overall accuracy rating of 86.21%, indicating that it was fairly effective at correctly categorizing the photos. To ensure the reliability of their results, scientists used a technique known as 10-fold cross validation, which prevents the computer from becoming very adept at detecting just previously seen images. The findings show that employing convolutional neural network-identified features can increase computers' ability to classify diverse skin disorders.

In March 2020 a research was done by Muhammad Naseer Bajwa [6] where Skin disorders can grow and manifest in a variety of ways, and sometimes even doctors are unable to detect and provide reliable results, then CAD enters the picture, and through the use of a program, they can be easily diagnosed. Deep Learning is a technique used in computer applications to help diagnose skin disorders. Deep learning is a technology that trains computers to learn and understand things the same way humans do. So, they used some of the best computer programs called Deep Neural Networks and trained them on two really big collections of skin pictures, called Derm Net and ISIC Archive. These collections have a ton of images of different skin problems. They also used something called "disease taxonomy," which is like a way of organizing diseases into groups, to help make these computer programs even better at identifying skin issues .
After training these computer programs, they tested them on Derm Net and found that they could identify different skin diseases with 80% accuracy, which means they were right about 80% of the time. They also had a really high score of 98% for something called "Area Under the Curve," which basically shows how well the program can separate different diseases from each other. We also made a breakthrough by correctly identifying all 622 different types of skin issues in one set of pictures with about 67% accuracy. Plus, we got a really high score of 98% for our ability to separate these different issues from each other.In another collection of pictures called the ISIC Archive, we correctly identified all 7 main types of skin diseases with an average accuracy of 93%, and our ability to separate them was even better with a score of 99%.

III. DATA SET

In this research project, the Three classes of HAM10000 dataset are used that were obtained from Kaggle. The HAM10000 dataset is a collection of dermatoscopic images of skin lesions, designed for skin cancer classification tasks. This dataset includes several skin disorders The information is divided into three unique categories, each reflecting a different type of skin lesion. These categories include melanocytic nevus, melanoma and benign keratosis. The dataset is purposefully split into three subsets: training, validation, and testing, to aid in the model training process. Roughly 70% of the data is used to train the model, 20% is used for validation, and the remaining 10% is used for testing. The partitioning process guarantees an equitable representation of all seven classes inside each subset, hence facilitating the creation and assessment of robust models. The machine learning model's generalizability and dependability in the context of dermatological picture classification are enhanced by the well considered separation of the dataset into training, validation, and testing sets, as well as by keeping the dataset organized

IV. METHODOLOGY



` Figure 1: Methodology Followed

Our work uses a customized convolutional neural network (CNN)and pre-trained CNN models, Inception v3and VGG16, to alter the prediction of skin illnesses. The major goal is to develop a robust predictive model that can correctly and consistently diagnose a range of skin conditions.The packages numpy, pandas, matplotlib.pyplot, sklearn.model_selection, sklearn.linear_model, and sklearn.metrics were utilized in the implementation of our model.

A. DATA PREPARATION AND PROCESSING

We have chosen HAM10000 dataset which has 3297 dermatoscopic images , we have just classify the images into different classes by making 3 subfolders with the class labels name and put all the corresponding images into the corresponding subfolder.We have used the image data generator function to augment the images to increase it diversity and applied transformslike rescaling , shearing , zooming ,and brightness.Further we have normalized the images by rescaling the image pixel values between 0 to 1.

B. MODEL CONFIGURATION

We have chosen Inception and VGG16 and our customized CNN model , as we found Inception and VGG16 are very optimized for handling deep neural networks with residual connections and have proven success for high accuracy for image classification tasks with the help of transfer learning,We have used fine tuning approach on Inception and VGG16 and freeze the convolution layers and unfreeze the last convolution layers and added new dense layers with 256 neurons with rectified linear unit activation and output layer with 7 neurons and softmax activation for multiclass classification and for optimization Adam optimizer is used with 0.0004 learning rate.

C. EXPERIMENTAL SETUP

We have split our dataset into training , testing and validation set with a ratio of 7:2:1 .and run Inception and VGG16 on training and validation set for 10 epochs with a batch size = 32 , and learning rate of 0.0004 and dropout rate of 0.5 and used the adamoptimizer and implemented early stopping to monitor validation accuracy loss so that the model is trained uptill the best last epoch performance.After monitoring the validation accuracy for the pretrained model we minimized the learning rate to 0.0004 and added the dropout layer and did some changes in data augmentation parameters by setting rescale = 1./255 , zoom range = 0.2, shear_range = 0.1 and brightness range = [0.8,1.2] and it eventually reduced the overfitting of accuracy curves for our model .

D. MODEL EVALUATION

We have evaluated the performance of our pretrained models on the basis of training accuracy , validation accuracy , Training loss , validation , training precision, validation prediction and their combined graphs and eventually we made the confusion matrix to see how well our model is predicting the labels on the testing set. eventually displaying the number of true positives, true negatives, false positives, and false negatives for the testset.

E. HEATMAPS

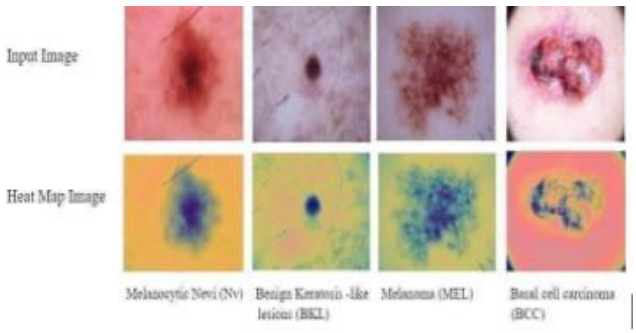


Figure 2: Illustrating Heat images Heatmaps:

Heatmaps: Illuminating Lesion Localization Heatmaps, in the context of dermatological image analysis, serve as powerful tools for lesion localization. These visual representations highlight the regions within an image that contribute most significantly to the identification of a particular skin condition. By decoding the intricacies of these heatmaps, we gain valuable insights into the diagnostic cues considered by deep learning models.

IV. RESULT

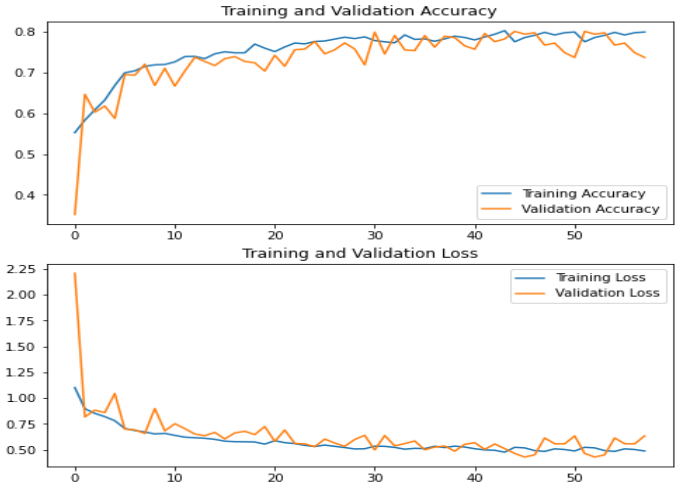


Figure 3: Graphical Representation of Accuracy of Vgg-16

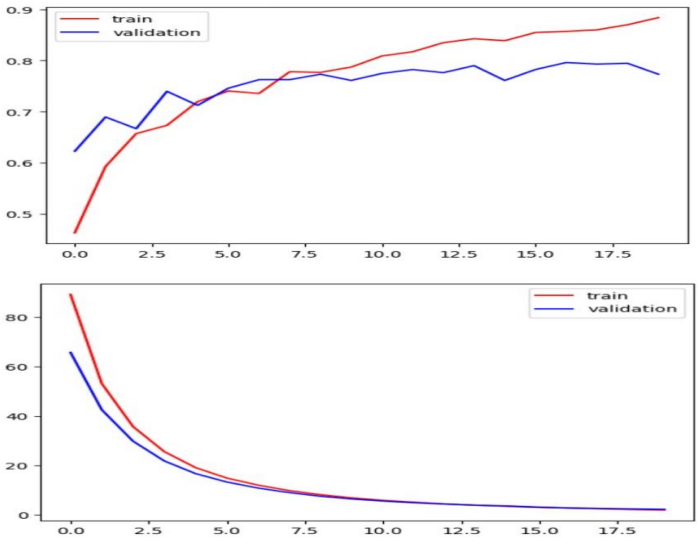


Figure 4: Graphical Representation of Accuracy of Inception

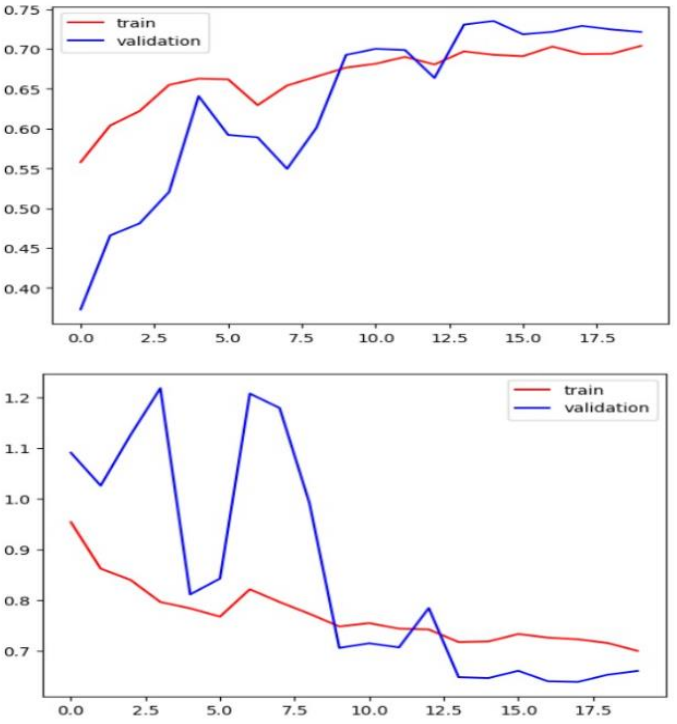


Figure 5: Graphical Representation of Accuracy of Custom Model

Model	Validation Data Accuracy	Train Data Accuracy
VGG-16	79.9%	86.6%
Inception-V3	77%	88%
Customized Model	72%	70%

Figure 6:Tabular Representation of Accuracy

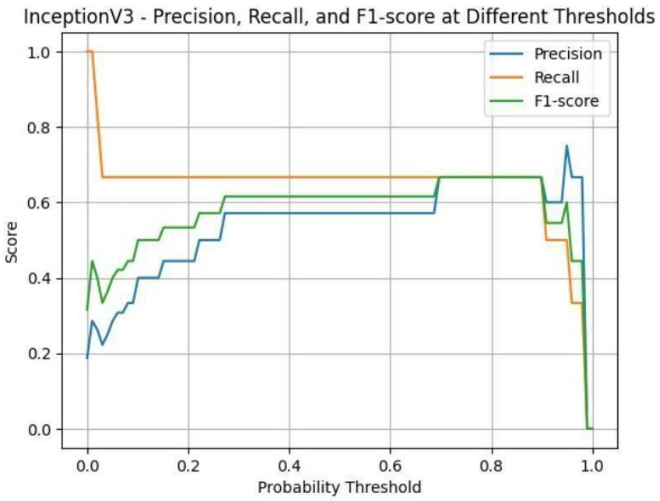


Figure 6: Graphical Representation of VGG-16

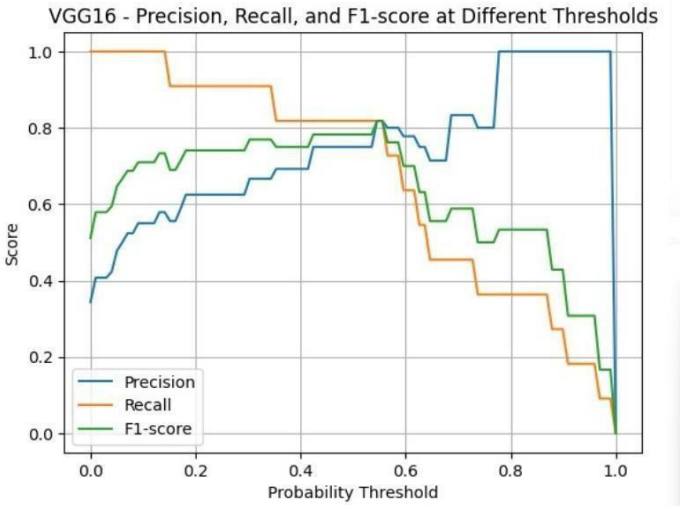


Figure 5: Graphical Representation of InceptionV3

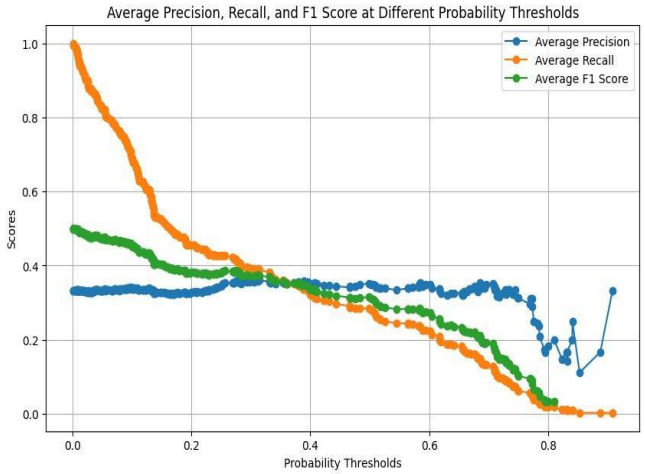


Figure 5: Graphical Representation of Custom Model

The model was trained for ten epochs, signifying that the entire dataset was processed 10 times during the training process.within each epoch, the dataset was divided into 73 batches, each consisting of 32 samples.

V. CONCLUSION

The researcher's goal is to analyze how a machine learning model i.e. convolutional neural network might be used to predict Skin Disease prediction. This study defines additional machine learning models and methods that have recently become popular for accurately and efficiently predicting Skin disease. According to the analysis, Vgg pretrained Model for Skin disease prediction has demonstrated an accuracy of 75% , with an accuracy rate of 77% on training data, and 75% on validation data. The Inception model has demonstrated an accuracy of 76% , with an accuracy rate of 88% on training data, and 77% on validation data. These pre-trained models will become more accurate at predicting Skin disease as it is worked on and trained with more high-quality data.

REFERENCES

[1]Viswanatha Reddy Allu Gunti. A machine learning model for skin disease classification using convolutional neural networks. Int J Comput Programming Database Manage 2022;3(1):141-147.

[2]Mahfouz MS, Al Qassim AY, Hakami FA, Alhazmi AK, Ashiri AM, Hakami AM, Khormi LM, Adawi YM, Jabrah AA. Common Skin Diseases and Their Psychosocial Impact among Jazan Population, Saudi Arabia: A Cross-Sectional Survey during 2023. Medicina (Kaunas). 2023 Sep 30;59(10):1753.

[3]P. Nagaraj, V. Muneeswaran, K. J. Krishna, K. Y. Reddy, J. R. Morries and G. P. Kumar, "Identification of Skin Diseases using a Novel Deep CNN," 2022 3rd International Conference on Electronics and Sustainable Communication Systems (ICESC), Coimbatore, India, 2022, pp. 992-997.

[4]R. EL SALEH, S. BAKHSHI and A. NAIT-ALI, "Deep convolutional neural network for face skin diseases identification," 2019 Fifth International Conference on Advances in Biomedical Engineering (ICABME), Tripoli, Lebanon, 2019, pp. 1-4.

[5]N. Hameed, A. M. Shabut and M. A. Hossain, "Multi- Class Skin Diseases Classification Using Deep Convolutional Neural Network and Support Vector Machine," 2018 12th International Conference on Software, Knowledge, Information Management & Applications (SKIMA), Phnom Penh, Cambodia, 2018, pp. 1-7

[6]Bajwa, M.N.; Muta, K.; Malik, M.I.; Siddiqui, S.A.; Braun, S.A.; Homey, B.; Dengel, A.; Ahmed, S. Computer-Aided Diagnosis of Skin Diseases Using Deep Neural Networks. Appl. Sci. 2020, 10, 2488.