Machine Learning Based Skin Disease Classification

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled "Machine Learning Based Skin Disease Classification", submitted by Md. Zayed Hassan Bhuiyan and Md. Tamjeed Monshi to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on January 2023.

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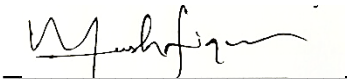

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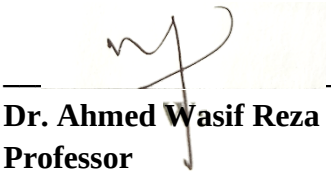

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Al Amin Biswas, Lecturer (Senior Scale), Department of CSE,** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Skin is the most sensitive and the largest organ in our body. Globally more than 35 million people are regularly affected by many types of skin-related diseases. Skin disease is too much danger in Bangladesh for people's lack of awareness. So, to classify those types of skin-related diseases give a proposed system that is related to image processing arising disease analysis is more claim full as they provide promising results in a short time and also used deep learning-based algorithms such as CNN (Convolutional Neural Network) and machine learning based algorithm SVM, Naive Bayes and K-Nearest Neighbor. Those algorithms are connected with image processing for classification and detection. This proposed method often detects whether the given images are impacted by any sort of disease of the skin or not. Here applies a knowledge set which is a combination of sub-continental data then train the data and also after testing those data we applied this technique to various diseases and finally we devise the greatest method that can easily detect those diseases. The first step is image processing with sub-continental data and the second step is using machine learning and deep learning based on the algorithm "Convolutional Neural Network" which can easily help to detect those samples which is given skin disease or not in a very low-cost way. This system can be used by any class of people who don't afford the high quality and expensive testing method comparing those algorithms, as a result, we probably achieved 83.86% accuracy by using CNN for the detection of various types of skin disease with disease name. CNN gives better performance among them because it can be detected normal skin as well as abnormal skin with great accuracy.

Keywords: Machine Learning, Artificial Intelligence, Image Processing, Convolution Neural Network, Skin diseases classification.

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CHAPTER 1
INTRODUCTION

1.1 Overview

Skin disease is a big problem in the world today and one-fourth of the world's people are affected by this disease. Skin diseases are actually mental as well as physical disorders that are infected both males and females. Skin diseases are now making young people mentally damaged because we are much more skin-conscious and beautiful worshipers. Dermatitis is caused by fungal and bacterial infections. Dermatitis is a contagious disease that spreads from one person to another. If we notice, we can see that some common skin-related diseases like bruises, Acne, Nail fungus, Hair fall allergies, Mesothelioma, and Eczema are constantly consuming young and adults just out of our unconsciousness. Skin disease may cause blister, inflammation, and also itching the skin changes rapidly. Some skin diseases are related to genetics also some factors depend on lifestyle. Dermatological diseases are the most conventional disease in the whole world. Skin is most sensitive organ for our health. Skin can help to keep our intestinal organs healthy by easily tolerating all types of external body temperatures and stress. Skin diseases now move on skin cancer because of weather fact. Skin disease can harmful for detect at an early stage because of lacking of medical tools, some proper treatment, proper equipment and lack of medical sagacity. If it is possible to diagnose skin disease at an early stage, then this disease can be cured very easily. When the skin is not diagnosed accurately, it can lead to major problems due to incorrect treatment and the disease progresses and often leads to cancer. If very harmful when it had cancer. That's why to overcome this obstacle we are going to devising a method that can easily predict skin disease through image processing. We are basically moving forward with 10 common skin diseases which can detect easily through image processing by using Convolutional Neural Network (CNN) algorithm within very short time and in initial stage. We used two algorithms to complete our research process, one Convolutional Neural Network (CNN) and the other Support Vector Machine (SVM). CNN has the best accuracy between CNN and SVM, so we have done our Skin Disease Prediction with CNN. This method can detect both of the healthy and unhealthy skin. If the skin

is infected it show the detection result according with disease name. That's why we propose Convolution Neural Network for applying our method.

1.2 Motivation

In today's world, skin disease has become a big problem. In almost all countries, people are suffering from skin diseases and they are facing a lot of problems due to lack of proper treatment. To solve this problem, we have proposed in our thesis a way to control skin diseases. We have found an easy way to get out of this problem. We offer image processing to diagnose skin diseases where only a camera and a computer can detect skin diseases at very low cost. Many low-income people cannot afford to treat skin diseases because of the high cost of skin diseases, which can lead to serious skin cancer. People in remote areas cannot diagnose the disease properly without a good doctor, so they have to face many big problems as their disease continues to grow. Considering all this, diagnosing skin diseases through image processing can be a great solution at a very low cost and in a very short time with just a camera and a computer.

1.3 Objective

The purpose of our research paper is to accurately diagnose the disease at low cost. Since dermatitis is a deadly disease, people have to spend a lot of money and trouble to diagnose it accurately. So, we have tried to diagnose this disease at low cost in less time. We tried to diagnose the disease using image processing using the CNN algorithm and we were able to do it accurately. We have created our data set by collecting images of different skin diseases like Eczema, Warts Molluscum and other Viral Infections, Melanoma, Atopic Dermatitis, Basal Cell Carcinoma (BCC), Melanocytic Nevi (NV), Benign Keratosis-like Lesions (BKL), Psoriasis pictures Lichen Planus and related diseases, Seborrheic Keratoses and other Benign Tumors, Tinea Ringworm Candidiasis and other Fungal Infections and applied the data set by training and testing with the help of SVM algorithm. Various author has shown that they have completed this process almost five diseases but the accuracy of detection process is too low than ours. We try to working on our project we have done the work of diagnosing ten common skin disease but those vary effective to lead cancer easily. Detection of this skin disease in first steps, take some pictures with the help of mobile phone or computer cameras

through image processing and understand easily what kind of disease they infected. Our initiative for all classes of people who don't aware of their health and don't bear the properly treatment which costly for impoverished people.

1.4 Report Layout

This report is organized as follows:

- In Chapter 02, we will discuss the literature review of the project like the related work and the studies behind it, include all the recent papers study and make comparison.
- In Chapter 03, we will discuss the methodology of our project which we used before.
- In chapter 04, we are focusing on experimental results and discussion of the system.
- In Chapter 05, we will discuss about conclusion and the future scope of the research-based project is described.

CHAPTER 2
BACKGROUND

2.1 Literature Review

Most of the author apply image processing-based method to classify the skin disease. By reviewing some literature, we basically get a full and overall idea about our topic. This good literature review is one of the main themes of our paper. Dermatologist disease is one of the major problems in our daily life. Most of person in world badly faces of this. So, some good researcher works a lot of things on skin disease which very rewarding and favorable. Its noticeable that most of the researcher mainly used the image processing medium for detect disease in in early stages and their accuracy level is so high remarkable.

Using different methods by ALEnezi et al. [1] their paper of skin disease detection using image processing and machine learning. They proposed an image-based method to detect skin disease or not. Digital pictures are taken of the part of the skin where the disease occurs. They used compiled data set where the database has so images for every disease. They work on three disease which is Melanoma, Eczema and Psoriasis. Diagnosis is made using pictures. There system is much simpler and much less expensive because one camera and one computer are enough to use this method. They complied their dataset from different website specific to skin diseases. In this paper the database has 80 images of every disease (20 normal images, 20 melanoma,20 eczema,20 psoriasis). The methodology of the proposed system for detection, extraction and classification of the skin diseases. The system will help significantly in the detection of melanoma, eczema and psoriasis. For solve this problem they use CNN. The system is implemented in MATLAB 2018b. They used a platform of Intel Core i3 processor 2.10 GHz with 4- GB RAM. The proposed system can successfully detect 3 different skin diseases with an accuracy is very high. It is the goal of this paper of Bhadula et al. [2] to apply five different algorithms like random forest, Naïve Bayes, Logistic regression, kernel SVM and CNN. Through they apply those algorithms in three different skin disease like acne, lichen planes and SJS ten but they find out the

best accuracy on applying CNN which accuracy level is too high that 99.00% but their method is too much time consuming.

In this research of Mohammed et al. [3] The author applied two ways to classify skin disease. One is traditional approach and another is Deep learning-based approach. They basically work on ultraviolet rays from the Sun cause skin cancer ultraviolet effect our skin directly because externally the sun kisses us directly. They focused on naïve bias algorithm that they got accuracy rate 90.00% on it where the data set was small or large is not any fact. So sometimes they don't get accepted outcome. The rest of the research includes four sections. In the first section, data set and machine learning algorithms. The second section, an overview of the literature. The third section, for the discussion, and the last section is set for the conclusion.

Focusing on artificial neural network algorithm to used identify skin cancer, Bourouis et al. [4] They also used image-based processing method to detect skin disease cancer. They applied a very low-cost method which can use any classes of people in globally. They inspired us to develop a novel M-health solution which distinguish between normal and abnormal image. They also applied CNN algorithm to brainchild their idea and got better accuracy. This inspired us to develop a novel M-Health solution which distinguishes between normal skin images and abnormal images using mobile neural networks. Therefore, in classification of skin disease using image processing and SVM by Kumar et al. [5] helps to detect skin related cancer Melanoma the most common deadly cancer of skin. Which ones attracts our skin doesn't well soon. So, their contribution to detect Melanoma in very early stages and prevention easily. They also focused on level data and proposed image-based data to help of support vector machine learning algorithm. They applied this by python programming They proposed RGB format and convert into 1- dimensional array to set their database. They also used Enum function to classify Melanoma and found accuracy 99.00% on SVM.

Verma et al. [6] used a methodology to create a photo type to detect skin disease by using basis of CNN. That's why they invented that disease-related question and disease type using and answers. Their ML technique in invoke 3 types processing. They use Python experiment result and develop website UI base where image is given as input

and detection result is got. Other author described in skin disease prediction that their method detects any type of skin disease by using CNN. They also used to help of ResNet-152V2 algorithm. Two types of methodology they used in their paper. But the percentage of their accuracy is not clear. In a research paper by Ponmalar et al. [7] expert skin disease identification system using machine learning. They focused on user interface system where affected area's picture given and then the result showing with disease name. They used Sobel operation is used for image edge detection. Normal skin and affected skin sometimes look like same that's why they apply sharpening filter function which improve the contrast of the image edge. Their applied method jus-1 perform on specific images for train and test data. They also took the help of CNN in this case but didn't show any accuracy result. They tested various disease without accuracy and computer vision extract the order from the image while combined with CNN.

2.2 Comparison

Many studies have tried to exploit the performance of Deep Learning in favor of dermatology, especially for the diagnosis of skin diseases. However, few studies that were interest to a universal classification of skin disease, most of them restrict the problem to certain skin diseases, such as melanoma, which is a deadly cancer. In this section, we review the various existing work in the literature for the purpose of detecting and classifying skin lesion by exploiting the different techniques of Deep Learning, by focusing more on the research that has been developed with the DermNet database. Looking at previous works, the research by Bajwa et al [17] proved that DL have enormous potential to classify a vast array of skin diseases challenging the human performance, they used two techniques in their researcher, they first focus on classification of 23 skin classes lesions and achieved 80% accuracy and 98% AUC. In second phase, they achieved 67% accuracy and 98% AUC in classification of 622 distinct sub-classes in DermNet dataset. Sah et al. in [18], highlighted the role of image processing part and image augmentation to improve the accuracy of skin lesion classification. They investigated the ability of deep CNN models trained with DermNet dataset to achieve a good recognition rate. Esteva et al. in [19], proved that deep neural networks (DNN) rival human performance, by building a strong system that attracted a big attention, they developed a NN-based system that can diagnose cancer from skin

image, reaching the level of human dermatologists. They achieved 60.0% top-1 accuracy and 80.3% top-3 accuracy classification, outperforming human specialists' performance. Haofu Liao proposed two works. In the first, he suggested a global skin disease diagnostic system using deep convolutional neural network (CNN) [20], achieving 73.1% Top-1 accuracy and 91.0% Top-5 accuracy. In 2016, he proposed a second work with other researchers [21], when they proved that using skin lesion characteristics facilitate skin disease diagnosis as many diseases are so similar in the visual aspects. Kawahara et al in [16] used the MobileNet network trained on a public library DermoFit and classified the skin lesions into ten categories. Works on skin lesion classification with deep learning methods are listed in Table 1.

Table 1: References of Skin Disease Classification with Deep Learning

Authors	Year	End point	Dataset	Result	Model
Bajwa et al.	2020	Classification of 23 diseases	DermNet database	Accuracy:80% AUC:98%	Fine-tuned DenseNet-161, SE-ResNeXt-101 and NASNet
Sah et al.	2019	Classification of 10 different classes of skin disease	DermNet database	Accuracy:76.3%	Fine-tuned of pretrained VGG16 model
Esteva et al	2017	Robust system of classification skin cancers	Clinical images dataset	Accuracy:55.4%	Pretrained Inception v3
Haofu Liao et al.	2016	Classification of 38 disease-targeted and lesion-targeted	AtlasDerm Derma DermIS Dermnet DermQuest	Top-1 accuracy:27.6% Top-5 accuracy:57.9%	AlexNet model trained from scratch and using fine-tuning
Kawahara et al	2016	Classification of skin lesions into ten categories	Dermofit	Accuracy:81.8%	Pretrained AlexNet
Haofu Liao	2015	Classification of 23 diseases	Dermnet OLE	Top-1 accuracy:73.1% Top-5 accuracy:91.0%	Deep convolutional neural network (CNN) using VGG19

2.3 Limitation of existing system

In one paper they don't briefly implement any method and don't discuss about computer tomography but they used this in their paper. Also, some paper has limitations when used huge number of images will trained then algorithm give better accuracy only. But when they applied this in smallest number of images, they don't get expected outcome. Most of their proposed system is too costly. Some author only compared their result with literature review but don't measure the percentage of the accuracy they only showed the web-based detection. In one paper we saw that they focus only on RGB format but either without RGB format disease can be detected.

CHAPTER 3
METHODOLOGY

3.1 Proposed system of Skin Disease Classification

We are basically working on skin disorder that can be easily identified at an early stage. Dermatological malady are very contagions and can easily spread from one person to another. That's the main focus of our system to detection skin disorder very hurriedly. We applied some common machine learning algorithm like SVM, CNN with image processing and we got well result from applying CNN. CNN is the best method for image processing uniquely and accurately. When a person affected any skin related disease like acne, skin allergy, hair follicles, nail fungus and also detect normal skin from this system. In our paper we proposed a valued skin disorder detector which detect disease in nail, skin of hair, allergy in skins and acne on skin. We train the data set in proper neural method to get valuable result. Our system can take RGB image from any angle of input image. The actual work of this image processing done by Convolutional Neural network operation filter the input images, classified the images and after features extraction for prediction those disease.

We give an image that convolutional work and ReLu processing is done because the convolutional layer worked as an image filter and ReLu (Rectified linear unit) works for non-linear and training time fasting. Then pooling layer and fully connected layers.

In our proposed method skin disorder can be detected from the divided images or using web camera. Firstly, the input image 150px*150px resizing and convert in 75px*75px and perform features extraction and go through the max polling layer with 38px*38px then ready for detection. Other’s tumult and representation filtered to remove high frequency from computing all things in the training process. It provides some model with great accuracy level.

In total system three parts are work out. The first part is connected the loading datasets and created a model with the accuracy rate and after all work the system can detect skin is normal or abnormal. If abnormal skin detects it showing the result with disease name.

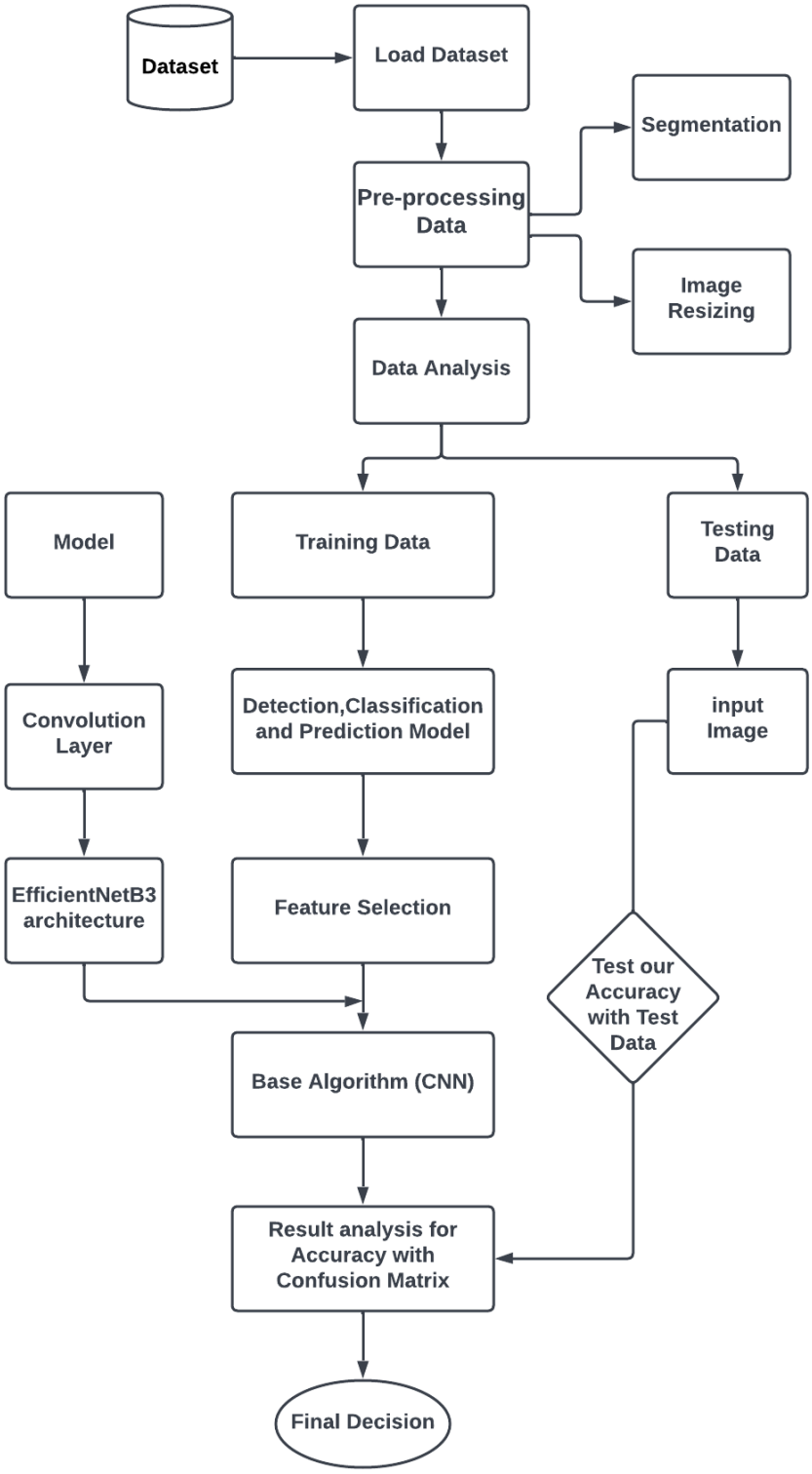

Figure 1: Propose System of Skin Disease Classification

3.2 Convolutional Neural Network

The main purpose of our work to using CNN for better performance. In system operation we discussed the fully working architecture for our proposed model to detection skin disorder in at early stage. Firstly, load the training and testing images amidst our python IDE. In our model it has three part which down consume amidst our IDE. Where it processing the actual dataset and then it will generate some modules with accuracy. Then it performs it works with three layers on this system which has convolutional layer, pooling layer, and fully connected layer. Firstly, few pixels of input images enter into the first convolutional + ReLu (Rectified Linear unit) where convolutional part filter the images and ReLu convert non-linear to 0 and fast the training time. Then it goes through on next layer which is pooling layer where image sizes reduce dimensionally. Then convoluted pixel move on to the next second convolutional layer.

After completing those features extraction tasks, it prepared to move on second max pooling layer and prepared for fully connected layer and finally it classified the images and detect the disease accurately.

1. Our first convolutional layer which is 150px kernels of size 3*3. Activation function is rectified neural network. And the max pooling size is 2*2.
2. Second convolutional layer size is 75px kernel of size 2*2. Activation function also ReLu and pooling layer is 2*2.
3. We have dense layer with 512neurons. ReLu is an activated function of this.
4. We also added flatten and drop out layer in our method.
5. Final layer has 5neurons that is, nail fungus, skin allergy, hair follicles, acne skin disease and also a normal skin. We used softmax as a final activation function.

3.3 Support Vector Machine

Support vector machine also an important part for image processing. For classified image and detection of any disease in also verified with SVM. Basically, SVM can take a decision boundary for classified multiclass problems. Hyperplane is a part of SVM

which took a decisions plan that divided between the given objects and classify those objects.

The main task of image classification is first read the input images. The computer see the data seems different. Computer see the data as an array of input images pixel. If the size of image is 150px*150px*3 where first 150px is width and second 150px is height and 3 is RGB values. Firstly, taking the input then model constructed after training and testing data the model can prepare for detection. SVM receive the main size of input image then it resizes those pixels of images for implementing. Features extraction of input image seems like as CNN procedure. This method is really very simple for image classification. Applying some features extraction techniques like drop out, flatten layer, pooling layer, dense layer, maxpool2D etc. to find the accurate image classification.

3.4 K-Nearest Neighbor

K-Nearest Neighbor is the simplest machine learning also image classification algorithm. It is non-parametric and use a database in which the data point are different into several classes to predict the classification. K-NN is too simple that it doesn't perform any types of learning. But for detecting which types of skin disease are affected K-NN helps to classify it easily. The goal of five types of skin disease dataset, as the disease name suggest it is to classify whether a given image contain acne, allergy, nail fungus, hair loss or normal skin. When we know anything about image classification firstly, we understand viewpoint variation, scale variation, deformation, Intra class variation etc. in K-NN algorithm. Simply it identifies unknown things by find most common class among the K-closet example to visualize this process five types of datapoint within each respective category are relatively connected together in dimensional space. In K-NN classification we need to define distance metric or similarity function.

When we supply the number if K-NN we classify the main data point. Because for classify a given data point is normal or abnormal, we'll default this value to one. So, meaning that an image will be classified by finding it nearest neighbor in dimensional space and label of closed image. Then finally detect skin disease present or the given images are normal. And showing the image with exact disease name accurately

Euclidean Distance Function

$$d(p,q) = \sqrt{\Sigma_{i-1}^{N}(q_1 - p_1)^2}$$

Manhattan Distance Function

$$d(p,q) = \Sigma_{i-1}^{N}|q_1 - p_1|$$

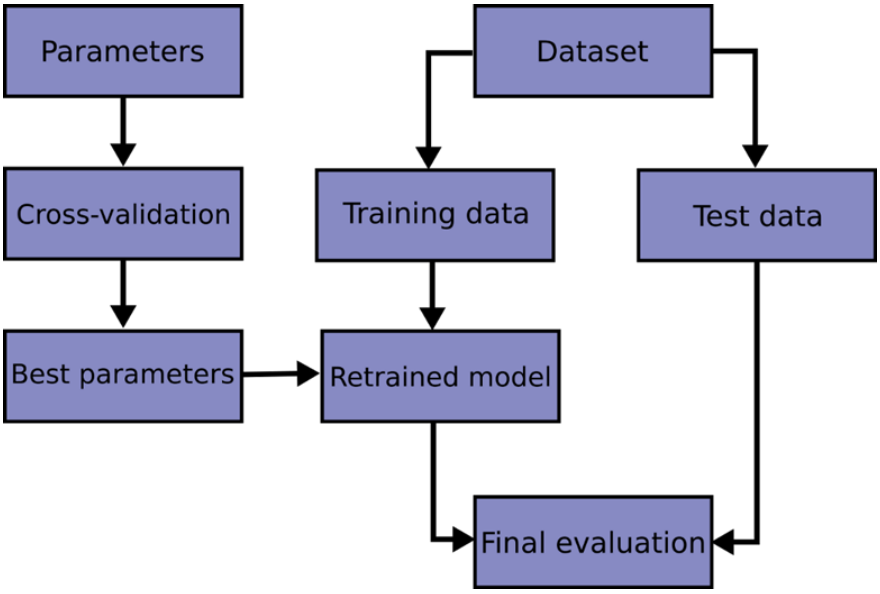

Figure 2: System Architecture of KNN

3.5 Naive Bayes

We know that naive bayes is popular for easily understand classification algorithm. It's able to assigning a class on given input. Like when we putting the normal and abnormal image it's label the image and saying the given images are normal or abnormal. This algorithm learns by looking forward an example that are accurately classified. Basically, it's a probabilistic classifier as well. The class or label of image are predicted as a result of creating probability, distributions of all data it is shown then decides which one is related its exact disease name When it found some similarity it follows two things for predicting.

A) Probability of symptoms or similarity of skin disease images.

B) probability of being normal skin as don't show the same features.

It assumes that each and all features are different from another. Also, assuming that no similarity between normal and abnormal skin So for classified we need to apply bayes theorem.

$$P(A|B) = P(B|A) * P(A) / P(B) \qquad (1)$$

Considering all the given conditions as an image of skin allergy given a set of features it can predict and observe skin allergy. And no possibility of similarity matches it shows the given features as normal skin.

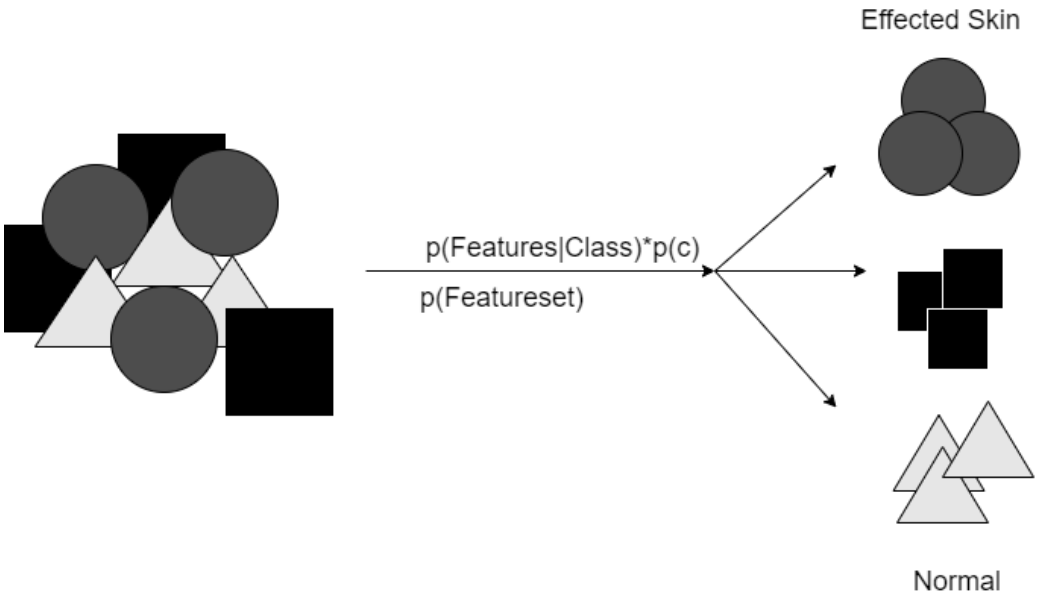

Figure 3: System Architecture of Naive Bayes

3.6 Dataset Information

For our thesis, we collect data set from Kaggle websites and moved dataset to google drive to use in google colab. After collecting data set firstly, we preprocess the whole data according with unique disease name such as Melanocytic Nevi (NV), Basal Cell Carcinoma (BCC), Melanoma, Warts Molluscum, and other Viral Infections, Benign Keratosis-like Lesions (BKL), Psoriasis pictures Lichen Planus and related diseases, Seborrheic Keratoses and other Benign Tumors, Tinea Ringworm Candidiasis and other Fungal Infections, Eczema, and Atopic Dermatitis. After pre-processing is completed, we supply levels of every image of each disease during training and testing those data. After the testing the dataset is ready to be use to classify skin diseases. We

performed our experiment about images in a dataset with infected areas and also normal areas 77% of training data and 23% of testing data were applied in our method.

Figure 4: Disease Visualization of Various Skin Diseases

CHAPTER 4

RESULT ANALYSIS

4.1 Experimental Result

We initialize the model training with number of epoch time defined. Epoch's time can be defined as user wishes but for this test, we run it for five times.

Table 2: Experimental Result of Applied Machine Learning Technique

Epoch	loss	Accuracy	Validation loss	Validation accuracy	Learning Rate	Next Learning Rate	Monitor	Improve in %	Duration
1 /40	7.107	50.855	5.04312	73.883	0.00100	0.00100	Accuracy	0.00	344.82
2 /40	4.066	66.680	2.97960	75.770	0.00100	0.00100	Accuracy	31.12	310.80
3 /40	2.525	74.205	1.87535	81.125	0.00100	0.00100	Accuracy	11.29	308.65
4 /40	1.664	79.304	1.35407	80.701	0.00100	0.00100	Accuracy	6.87	311.17
5 /40	1.165	83.867	1.11305	81.125	0.00100	0.00100	Accuracy	5.75	311.91

4.2 Model Description

This image graph shows the accuracy and validation graph while training. As we can see as loss is decreasing accuracy increasing. We've got 83.88% accuracy on test set.

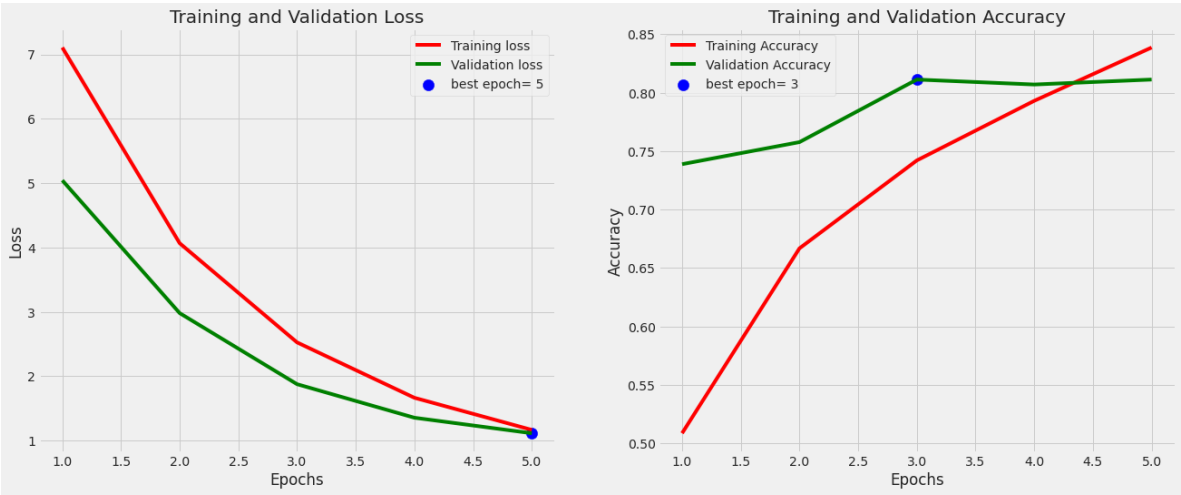

Figure 5: Training and Validation Loss with Accuracy

Table 3: Confusion Matrix Evaluation

	Actual Positive (1)	Actual Negative (0)
Predicted Positive (1)	True Positive (TPs)	False Positive (FPs)
Predicted Negative (0)	False Negative (FNs)	True Negative (TNs)

Figure 6: Confusion Matrix of CNN

Table 4: Classification Report of CNN

Disease Name	**Precision**	**recall**	**f1-score**	**support**
Atopic_Dermatitis	0.55	0.65	0.59	126
Basal_Cell_Carcinoma	0.94	0.86	0.90	332
Benign_Keratosis-like_Lesions	0.68	0.88	0.77	208
Eczema	0.64	0.69	0.66	167
Melanocytic_Nevi	0.98	0.91	0.94	797
Melanoma	0.93	0.99	0.96	314
Psoriasis_pictures_Lichen_Planus_and_related_diseases	0.54	0.65	0.59	86
Seborrheic_Keratoses_and_other_Benign_Tumors	0.71	0.86	0.78	185
Tinea_Ringworm_Candidiasis_and_other_Fungal_Infections	0.76	0.56	0.64	170
Warts_Molluscum_and_other_Viral_Infections	0.76	0.59	0.66	211
accuracy			0.82	2596
macro avg	0.75	0.76	0.75	2596
weighted avg	0.83	0.82	0.82	2596

When input a skin disease image to our system, the system can detect which skin disease the image corresponds to and can name the disease. This is a very simple process and through this process it is possible to diagnose skin diseases accurately. I think people will benefit a lot from this project of diagnosing disease through image processing and when we can turn it into a mobile application it will be easier and less costly.

CHAPTER 5

Impact on Society, Environment and Sustainability

5.1 Impact on Society

The implementation of machine learning-based skin disease detection can have a significant impact on society. By using algorithms to analyze images of skin, it is possible to quickly and accurately diagnose skin diseases, reducing the time and cost associated with traditional methods. This can help individuals receive the proper treatment for their skin condition more quickly, reducing the risk of the condition getting worse or becoming permanent. Additionally, it could lead to improved patient outcomes and increased accessibility to skin disease diagnosis, especially in rural or under-resourced areas where access to medical professionals may be limited. The widespread use of our system has the potential to greatly improve the overall health and quality of life for individuals suffering from skin conditions. So, we can say our system can make an impact on society and help people with a low cast and in an effective way.

5.2 Impact on Environment

Our system has no direct impact on the environment. It is a computer-based technology that is used to diagnose skin diseases by analyzing images of skin. The impact of machine learning in this field is mainly on healthcare and patient outcomes, making it easier and more accessible for people to receive accurate and timely diagnoses, which can lead to more effective treatment and better health outcomes. However, the production and use of the technology, like any other technology, can have indirect environmental impacts such as energy consumption, waste generation, and greenhouse gas emissions associated with the production, use, and disposal of the technology. Additionally, the development and deployment of our system can help reduce waste and improve resource utilization by reducing the need for expensive, resource-intensive diagnostic procedures, such as biopsies, which have larger impact. These impacts can be reduced through sustainable practices in the production and use of technology. We are trying to minimize the impact and taking necessary precaution to handle this situation.

5.3 Ethical Aspects

The use of machine learning for skin disease detection raises several ethical concerns, such as data privacy, bias in training data, and accountability for misdiagnosis.

Data privacy is a major concern in any machine learning application that involves personal health information. In the case of skin disease detection, the images used to train and test the algorithms may contain sensitive information that could be used to identify individuals. It's important to ensure that all data is properly anonymized and stored securely to prevent unauthorized access.

Another ethical issue with machine learning-based skin disease detection is the potential for bias in the training data. The algorithms are only as good as the data they are trained on, so if the training data is biased in any way, the algorithms will likely make biased predictions as well. This could lead to unequal treatment of certain populations, such as marginalized or minority groups.

Finally, there is the issue of accountability for misdiagnosis. Machine learning algorithms are not perfect, and there is always the possibility of misdiagnosis, which could have serious consequences for the patient. It's important to ensure that clear guidelines are in place for how to handle misdiagnosis, and that those who are responsible for developing and deploying these systems are held accountable for their actions.

5.4 Sustainability Plan

The sustainability plan of our system would considering its environmental, social, and economic impacts. This includes reducing its energy consumption and carbon footprint, addressing ethical concerns around privacy and biases, and ensuring its long-term financial viability while benefiting patients, healthcare providers, and society. The plan should consider the interrelated impacts of the technology to ensure its sustainability in the long-term.

CHAPTER 6

FUTURE WORKS AND CONCLUSION

6.1 Summary of the Study

In this research work we collected data from online source and we pre-trained a model. To train the model we used some portions of our dataset. The rest of the dataset is used to test the model and validate the output to determine the accuracy. We used CNN (Convolutional Neural Network) for our research. Our work will help all kinds of people to detect possible skin disease and diagnosis of that disease will be easier.

6.2 Conclusion

Diagnosing skin diseases is a very difficult system for medical science. If the skin disease is not diagnosed accurately, the patient has to suffer a lot. This is because the disease continues to grow due to wrong treatment and at one time it goes to the extreme stage. That's why people are exposed to a lot of hazardous situations which later turn out to be even more horrific and finally it led to deadly skin cancer. Dermatitis often becomes permanent and there is no way to get rid of this disease even after many expensive treatments. It is much easier to get rid of this disease if you can diagnose it at an early stage. An easy and inexpensive way to diagnose a disease through image processing using machine learning algorithms. Diagnosis of skin diseases through image processing can be a very popular method and people from all walks of life can diagnose skin diseases through this method in a very short time at very low cost.

6.3 Implication for Further Study

In this thesis, proposed to diagnose the disease through image processing with the help of machine learning and we have implemented it. We want to work with many more big data sets in the future and create a mobile application. And with this mobile app we will created, skin diseases can be diagnosed instantly by taking pictures directly from the body or scanning the pictures taken earlier.

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