SKIN DISEASE DETECTION

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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

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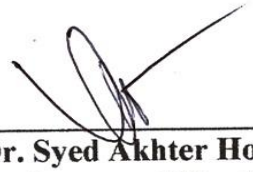

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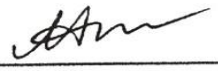

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We hereby declare that, this project has been done by us under the supervision of **Samia Nawshin, lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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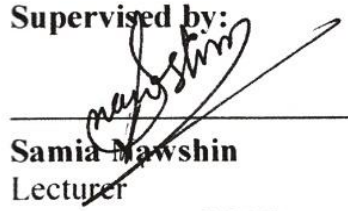

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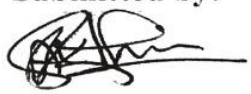

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ABSTRACT

The fundamental objective of this project is to design a prototype system which can be used to detect skin diseases that are Acne detection, Scabies detection, Melanoma detection, Nevus detection, Seborrheic keratosis. This paper focuses on improving the image processing techniques to increase the quality of image and neural network techniques to organize the skin diseases listed above. The blueprint is based on TensorFlow which is mainly used for classification, perception, prediction and creation since it is an open source artificial intelligence library and retraining image classifier using complex neural network. The prototype has been experimented on four variety of skin diseases. When a sample test image is given to prototype, the image will be tested using old trained complex network model. As a result, by implementing this technique skin diseases are recognized with up to 99.52 percent accuracy rates. This prototype has the capability of further improvement in the future. This project has an API endpoint which is the point of entry in a communication channel. When two systems are interacting for Android application and IOS it can be used very methodically by sharing skin diseases' images.

This project has another objective which is to deliver as much information as possible regarding skin diseases detection with this prototype to the general public.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

One of the most important part of human body which is the skin that contains blood vessels, lymphatic vessels, nerves, and muscles which can perspire and perceive the external temperature. It protects our body from many viruses and bacteria that we are exposed to everyday. It also guards us from the sun's rays specially from ultraviolet light that can destroy cells from human body but variety of skin diseases can also cause huge problem such as pimples, scabies, pyodermas etc. About 72.3% of men and 58.0% of women are affected by various skin diseases all over the world. It is very difficult and challenging for one to determine what skin disease they are suffering from except visiting a doctor and paying large amount of money in most cases. But using neural network techniques we can detect what skin diseases the victims are suffering from. Accurate diagnosis and proper evaluation of skin disease is a critical component for a safe healthy life and we aim to do so.

In this paper we propose an automated system integrated with computer vision techniques that will assist the humans to get accurate information about their skins using their mobile phone or computer browser. The first step is to take picture of the affected skin region, then the picture will be uploaded to the system. The uploaded picture of the affected skin region will be evaluated in the central server and it will be replied with the disease name of the skin if it matches with four diseases is was trained on.

1.2 Motivation

Today we are in digital era. Technologies are around us to make our lives easier. We can solve so many problems that we are facing in our daily lives. There are lots of people around the world who are suffering from skin diseases even though they do not know what kind of problem they are facing. By using modern technologies such as Artificial Intelligence and Machine Learning, we can find out such problems quite easily and effectively. Later on, such infected people can go to doctors for further treatment. Also, that can be quite unnecessary as a lot of these cures are already available on the internet. Modern health care increasingly expensive though the treatment is available this makes it difficult for people to engage such attempts offend the cost of cure is negligible compare to the appointment fee of a good dermatologist. Although a large majority of people suffer from some sort of skin diseases, major or minor, most of such people are very reluctant look for a cure and they will perhaps never visit the doctor. Once the situation worsens to a degree where their lives become miserable, the last resort becomes the doctors with high treatment expenses and suffering. In development country such as Bangladesh pollution such as dust pollution air pollution and lack of proper hygiene are fundamental lifestyle of the people. No proper well-developed facilities are available for the mass public to seek assistance from. The severity of the situation is only felt by the victims who suffer every day, affecting their everyday livelihood. Others are misguided by the very inexpensive creams and tablets that are found and distributed in foods stall and on roads. Such an advantage of inept support for Medicare is taken by dishonest people with no authority to counterfeit them.

Programming languages and their libraries have helped us to improve our understanding in connecting to human being more closely. One of its fruits, image processing, falls under the branch of AI and ML. With the help of such technologies we are able to develop a “neural network” which help us to study various images of skin diseases and provide feedbacks such as their classification.

1.3 Rationale of the study

As we all already know that skin diseases are common among most people and can turn out to be severe for some, it is high time for a solution in this age where hygiene is a fundamental requirement of our lives.

Carelessness, lack of proper illness detection are the two main reasons for this problem. There is no social uprising in this matter, thus further helping the spread of skin diseases.

All of these problems can be tackled with the ever-increasing help of technology. With proper detection of skin diseases, people can know about their diseases on a personal level and thereby encouraging them further to take proper medical attention. A healthier population, working class, friends and family will yield better for the society in the short run and prosper in the long run.

1.4 Research questions

- Why affected people are reluctant to go for cure?
- What are the major advantages of incorporating technology in skin disease detection?

1.5 Output

- Identification of appropriate diseases
- Reduction of spread and growing of diseases
- Reduction in health care treatment costs
- Additional helping hand to medical sector
- Increased hygiene of the overall population

1.6 Report layout

There are five chapters in this research paper. They are: Introduction, Background, Research Methodology, Experimental Results and Discussion, AND Summary, Conclusion, Recommendation and Implication for Future Research.

Chapter 1: Introduction; Introduction, Motivation, Rationale of the Study, Research Questions, Output, Report Layout.

Chapter 2: Background; Introduction, Related Works, Comparative Study, Research Summary, Scope of the Problem, Challenges.

Chapter 3: Research Methodology; Introduction, Research Subject and Instrumentation, Data Collection Procedure, Implementation Requirements.

Chapter 4: Experimental Results and Discussion; Introduction, Experimental Results, Descriptive Analysis, Summary.

Chapter 5: Summary, Conclusion, Recommendation and Implication for Future Research; Summary of the Study, Conclusions, Recommendations, Implication for Further Study.

CHAPTER 2

BACKGROUND

2.1 Introduction

In our country most of the skin diseases that affect human beings are either result of our own carelessness, lack of hygienic behavior, constant changes in the environment, toxic food and just bad luck. These skin diseases do not discriminate people of any age. Skin diseases can affect a newborn child or a very elderly person. Skin diseases can cause severe pain and discomfort rendering the patient's everyday normal life paralyzed. Although it is very easy to be affected by skin diseases it is very difficult to detect what skin diseases are affecting us and how to cure them.

There are many skin diseases that are common all over the world. Such types of skin diseases are, eczema, psoriasis, rosacea, ichthyosis, vitiligo, hives, dermatitis, scabies, pyoderma etc. For applying machine vision-based disease recognition based on visual symptoms, this paper focuses on four skin diseases named Acne, Scabies, Pyoderma, Eczema.

2.1.1 ACNE

The most common skin disorder all over the world is ACNE which can be a source of anxiety for every teen. Plus, the incidence of acne is growing in adults of all ages. Acne is caused by blocked hair follicles and oil (sebaceous) glands of the skin, often triggered by hormonal changes. The term acne refers to not only pimples on the face, but blackheads, cysts, and nodules as well. Some people get acne on other parts of their body too, such as the back and chest. Sample images shown in Figure 2.1.

Symptoms: Depending upon the condition acne signs and symptoms may vary. Such as:

- 1.Whiteheads
- 2.Blackheads
- 3.Small red, tender bumps
- 4.Pimples which are papules with pus at their tips
- 5.Large solid painful lumps beneath the surface of the skin

Figure 2.1: Acne disease

2.1.2 SCABIES

Mites known as the Sarcoptes scabiei is the cause of Scabies which is skin infestation. Untreated, these microscopic mites can live in our skin for a very long period. They reproduce on the surface of our skin and then burrow into it and lay eggs. This causes an itchy, red rush to form on the skin. Infested clothing or bedding can cause infestation of mites which means direct contacts isn't necessary for the mite infestation. Although scabies can be bothersome, they can usually be eliminated effectively. Sample images shown in Figure 2.2.

Symptoms: After initially being exposed to scabies, it can take up to six weeks to ten weeks which depends upon to the exposed victim if he was previously affected by Scabies, he can contract the Scabies even faster than before.

Most common affected region of Scabies are:

- Wrist
- armpit
- elbow
- Waist
- between the fingers

Figure 2.2: Scabies Diseases

2.1.3 Melanoma

Melanoma is a serious form of skin cancer that begins in cells known as melanocytes. Melanoma is far more dangerous because of its ability to spread to other organs more rapidly if it not treated at an early stage. Melanomas present in many different shapes, sizes and colors. Sample images shown in Figure 2.3.

Symptoms: Melanomas can develop anywhere on your body. They most often develop in areas that have had exposure to the sun, such as your back, legs, arms and face.

The first melanoma signs and symptoms often are:

- A change in an existing mole
- The development of a new pigmented or unusual-looking growth on your skin.

Figure 2.3: Melanoma Disease

2.1.4 Nevus

Nevus is the medical term for a mole. Nevi are very common. Common nevi are harmless collections of colored cells. They typically appear as small brown, tan, or pink spots. Sample images shown in Figure 2.4. There are many types of nevi. Some of them are harmless and others more serious.

There are some types of nevus. Such as:

- Congenital nevus
- Common nevus
- Dysplastic nevus
- Blue nevus
- Halo nevus
- Spitz nevus
- Reed nevus
- Halo nevus

Figure 2.4: Nevus Disease

2.1.5 Seborrheic keratosis

A seborrheic keratosis is a common noncancerous skin growth. People tend to get more of them as they get older. Seborrheic keratoses are usually brown, black or light tan. The growths look waxy, scaly and slightly raised. They usually appear on the head, neck, chest or back. Seborrheic keratoses are harmless and not contagious. But people may decide to have them removed if they become irritated by clothing. The skin condition often runs in families. Risk increases with the number of affected relatives. The risk of the diseases will increase with age. Sample images shown in Figure 2.5.

Symptoms: A seborrheic keratosis:

- Is round or oval shaped
- Has a characteristic "pasted on" look
- Is flat or slightly raised with a scaly surface
- Ranges in size from very small to more than 1 inch (2.5 centimeters) across
- May itch

Figure 2.5: Seborrheic keratosis disease

2.2 Related works

The function and application of machine-based vision techniques are rapidly growing in the field of medicine in the last few years, especially in the disease detection which ultimately saves millions of lives. However, there aren't many easy reliable solutions which offers portable solution that detects skin disease using image analysis.

There are also research on medical symptoms of skin diseases and devoted skin markers for chemical analysis. In [1] was discussed a chemical method to detect atopic dermatitis, psoriasis and contact dermatitis characterized by transcriptomic profiling. Potential disease was detected by the use of protein expression levels. In [2] was presented classification of skin lesions using Deep Convolutional Neural Network. Proposed model was trained from images, using only pixels and disease labels on the input. The research presents classification in two cases: keratinocyte carcinomas vs. seborrheic keratoses and malignant melanomas vs. nevi. In [3]was proposed a technique for melanoma skin cancer detection. Authors proposed a system which combines deep learning with proposed skin lesions ensemble method. In [4]was presented optoacoustic dermo copy model based on a function of excitation energy and penetration depth measures for skin analysis by the use of ultra-imaging.

2.3 Comparative Study

Looking toward the current position of computerized skin disease analysis systems, there are few explanations free which are still under research evolution. Certain restriction and defect are identified in those hence this solution tries affected the existing problems with different approach. This research project consider lot of researching in image processing and data mining for figure vacation what are the most able and accurate ways of using the novel techniques to produce a better solution for skin disease description and diagnosis.

In [5] we can find an up to date review over various machine learning methods applied to skin diagnosis and diseases detection. While in [6] we can find a wide comparison of mobile apps for skin monitoring and melanoma detection. The authors have compared several apps, discussed their potential in efficient image processing form smart phone camera and sensing technologies and also presented legal aspects of ethical, quality and transparent development of apps for medical use.

2.4 Research Summary

Confirmation, measurement and characterization of skin disease detection provides not only the basis for what next to be done but also who it is to do in order to minimize the liability. the aim is to identify different skin diseases. Analysis of skin disease by TensorFlow develops where something is out of order and partly identifies where the exposure had shifted. As example particular exposure sources can be linked to particular technologies, it will help determine what special and needed safety measurements are required to adjust the risk.

2.5 Scope of the problem

- The end users of this setup are for medical personals.
- This model is built by using TensorFlow which is an open source library released by google in 2015.
- 5 samples each of different skin disease will be used in this project.

2.6 Challenges

While building this model we were faced with many problems and obstacles. The main difficulty for us was how do we start as we did not have any prior experience with building a prototype like this. then the second problem we faced was collection of data which was very critical for our prototype to function with high accuracy. If we didn't gather a large variety of data our model wouldn't even work. this was more challenging as we didn't know from where to collect this data from. we also faced some obstacles to integrate TensorFlow trained model and to make it work since TensorFlow is a relatively a new open source library and didn't have enough experience to navigate it properly. furthermore, we needed to make our model as user friendly as possible so it would easier for everyone that will use this at a daily basis.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Understanding that real world problems are to be dealt with modern day technologies at hand and this dire situation should not be waited for any longer. The new era brings in weird and ambiguous diseases that make the suffers spend huge sums of money as their situations go towards extreme. Acne, Nevus, Eczema, Melanoma and other disturbing skin issues are in an ever-increasing rise with new methods of treatment scarce for the mass population of underdeveloped countries with doctors still inspecting and prescribing with stone-aged methods, unchallenged and careless. In a selected rural community of Dhamrai Upazila under Dhaka district, in 2012, 2645 patients attended a medical camp where 410(15.5%) patients had distinct and complex dermatoses with mostly men than women were infections. Few patients (2.7%) had more than one dermatosis. Fungal infection was the commonest infection seen (22.9%) and eczemas took an upper hand in non-infectious group (32.2%). According to WHO's data publication of 2017, deaths reached 3093 or 0.39% of overall deaths, ranking Bangladesh 63rd in the world. To counter the latter, AI has been used in this project with Machine Learning regression algorithms, programmed and compiled in Python. Universal datasets, ex from the internet, modern opensource libraries and updated techniques sum up the research methodologies.

3.2 Research Subject and Instrumentation

The objective of this study is to detect skin disease detection using TensorFlow image classifier. Then we apply python to use it effectively and make the best use of it. We used 'convolutional neural network' model to classify images based on different diseases. We have trained our convolutional neural network model over 900 images on five different diseases.

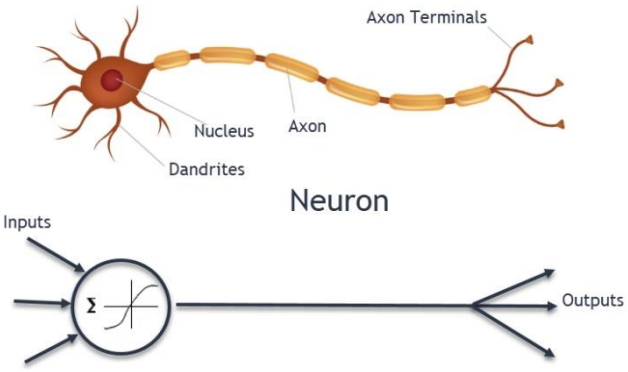

Figure 3.1: The structure of a simulated neuron, augmented with one from the real world.

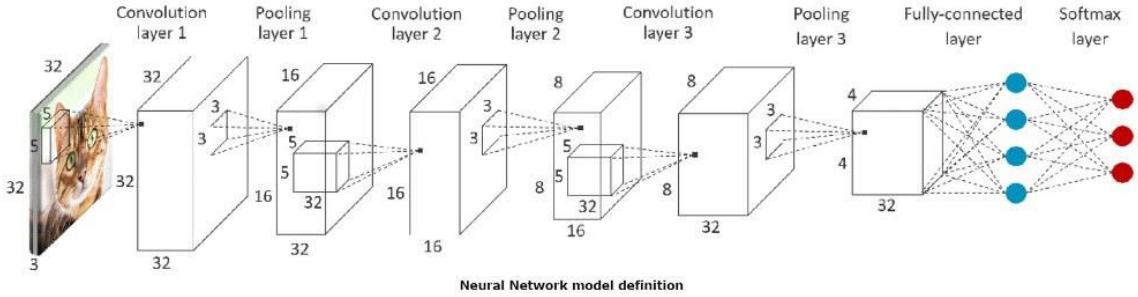

Figure 3.2: A complete neural network model involving the first phase, Convolution layer, followed by fully connected layer made up of neurons.

3.3 Data Collection Procedure

Fairly common skin diseases of the different areas of same regions are considered and moreover, a lot of the pictures, around 500, have been taken from Kaggle (a website for datasets) as both train and test images. More images are taken from other reliable sources. We have considered skin disease images with the physical parts. It has been observed that the proposed system output accuracy varies respect to skin diseases. We have also collected images from other sources of the internet as well. Over 900 images have been downloaded primarily on five different diseases which are Acne, Scabies, Melanoma, Nevus and Seborrheic Keratosis.

3.4 Implementation Requirements

Our main requirement for the project is Python and TensorFlow. We have trained our image classifier using convolutional neural network. We trained our classifier using transfer learning method based on Inception-v3 model which is trained for the Google ImageNet, Large Visual Recognition. We have retrained our classifier by running python for five different diseases. Future developments include a web interface built using Django, Python, and TensorFlow. Using this interface anyone can test their skin disease(s) by uploading affected image of skin using their smart phone or computer browser.

For implementation this project we need this requirement.

- Python environment setup
- Python IDE
- Download and import machine learning libraries.
- Download and import python libraries
- Manipulation tools like, TensorFlow, MATLAB, OpenCV
- 4gb ram computer with idle Processor

3.4.1 Retraining image classifier

TensorFlow is an end-to-end open-source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries, and community resources that lets researchers push the state-of-the-art in ML and developers easily build and deploy ML-powered applications. [7] Current image acknowledgment models have a great many parameters. Preparing them without any preparation requires a great deal of named preparing information and a ton of figuring power (many GPU-hours or more). Move learning is a system that easy routes quite a bit of this by taking a bit of a model that has just been prepared on a related assignment and reusing it in another model. In this instructional exercise, we will reuse the component extraction abilities from incredible image classifiers prepared on ImageNet and essentially train another order layer on top.

Modern image recognition models have millions of parameters. Training them from scratch requires a lot of labeled training data and a lot of computing power (hundreds of GPU-hours or more). Transfer learning is a technique that shortcuts much of this by taking a piece of a model that has already been trained on a related task and reusing it in a new model. In this tutorial, we will reuse the feature extraction capabilities from powerful image classifiers trained on ImageNet and simply train a new classification layer on top. [8]

Though it's not as good as training the full model, this is surprisingly effective for many applications, works with moderate amounts of training data (thousands, not millions of labeled images), and can be run in as little as thirty minutes on a laptop without a GPU. This tutorial will show you how to run the example script on your own images, and will explain some of the options you have to help control the training process.

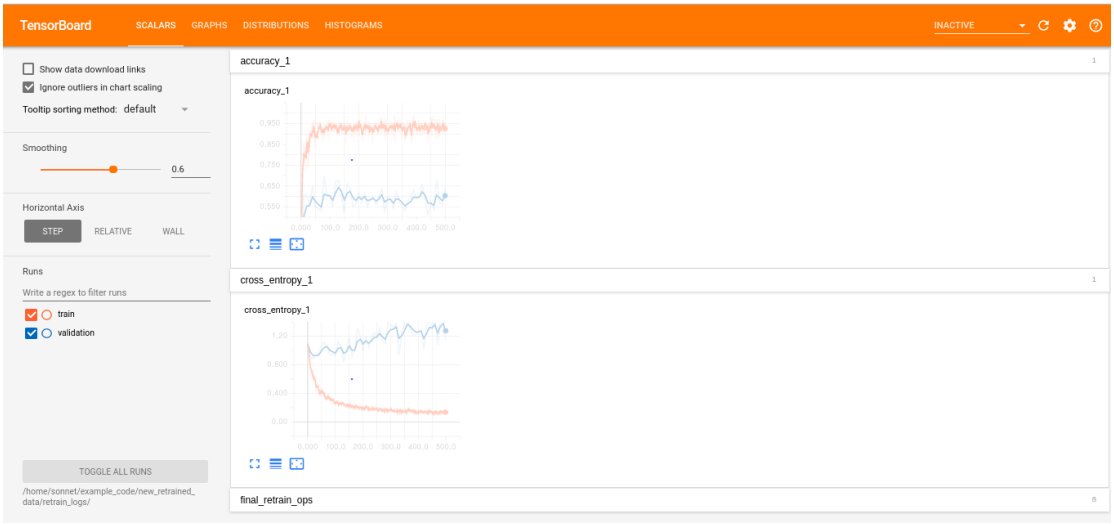

Figure 3.3: Tensor board graph for accuracy and cross entropy with train and validation.

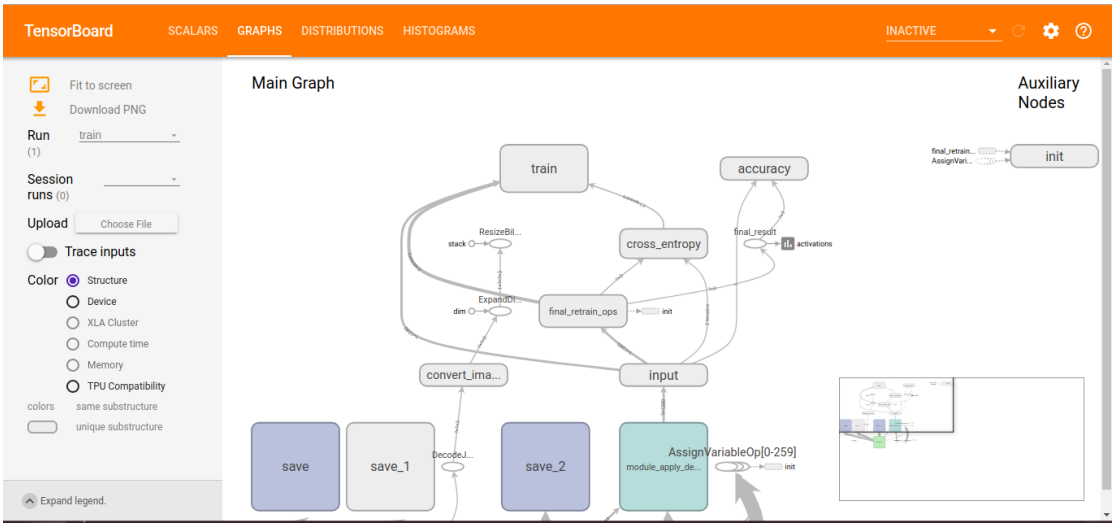

Figure 3.4: Tensor board main graph.

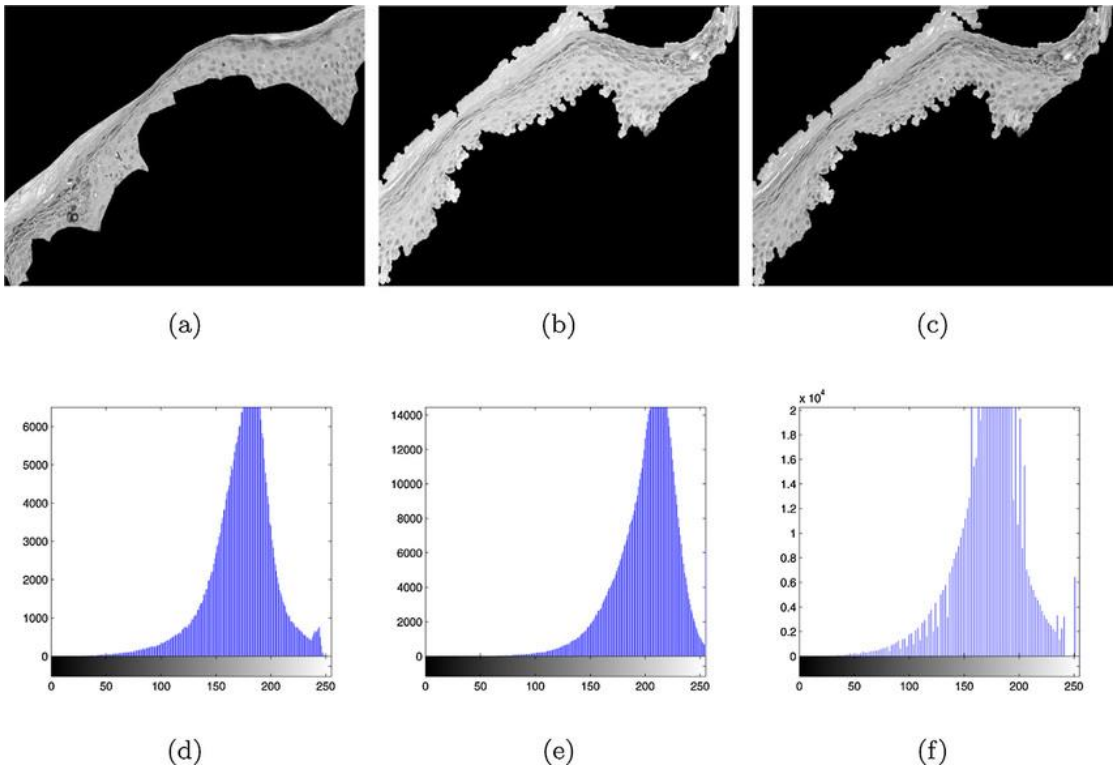

Figure 3.5: Histogram summaries for skin epidermis. [9]

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

Skin disease is a major problem among people worldwide. There are different machine learning techniques are already applied to identify skin disease. Herein, we have applied machine learning algorithms to categorize classes of skin disease using convolutional neural network based on inception-v3 to compare the result obtained. Machine learning algorithms are widely used in detect images. Various disease recognized algorithms have been refined to keep high accuracy for concluding disease. Many machine learning algorithms are developed for concluding various types of disease at early stages after researching the different attributes of the disease. These algorithms are relevant for detect skin disease

4.2 Experimental Result

The test report is wanted to reflect testing results in a formal way, which gives a scope estimate testing result speedily. Our project has need images for training after training that image it can recognize the images

The accuracy of any classification method is calculated using confusion matrix and is defined as –

Accuracy=Number of Correct Predictions/Total Number of Predictions

In another mode it can be represented as –

Accuracy=TP+TN/TP+TN+FP+FN

where TP = True Positives, TN = True Negatives, FP = False Positives and FN = False Negatives

Here is our accuracy rating of our project in Figure 4.1, 4.2, 4.3, 4.4.

Figure 4.1: Accuracy rate of Acnee.

Figure 4.2: Accuracy rate of scabies.

Figure 4.3: Accuracy rate of Seborrheic keratosis.

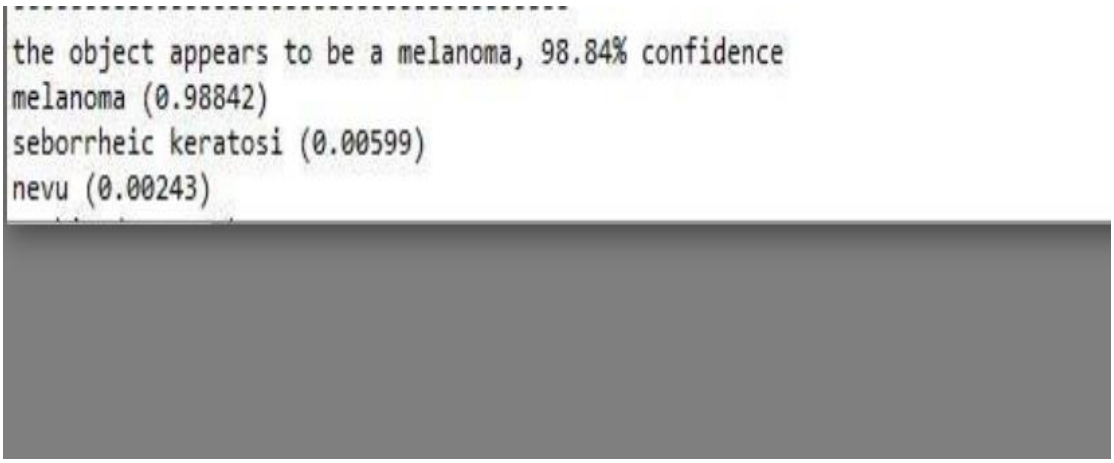

Figure 4.4: Accuracy rate of Melanoma.

Sample images from our project when the testing and training are running shown in Figure 4.5, 4.6.

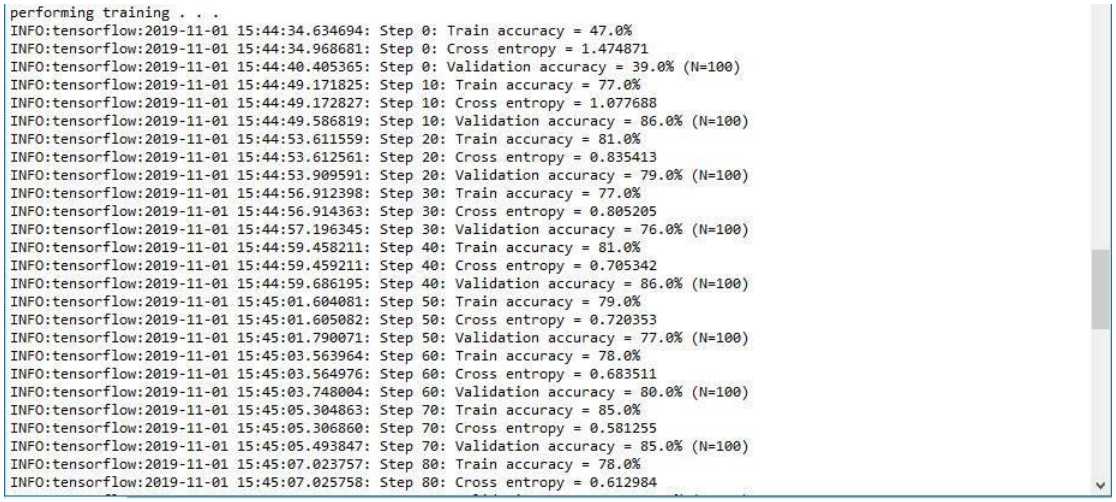

Figure 4.5: Training our Data

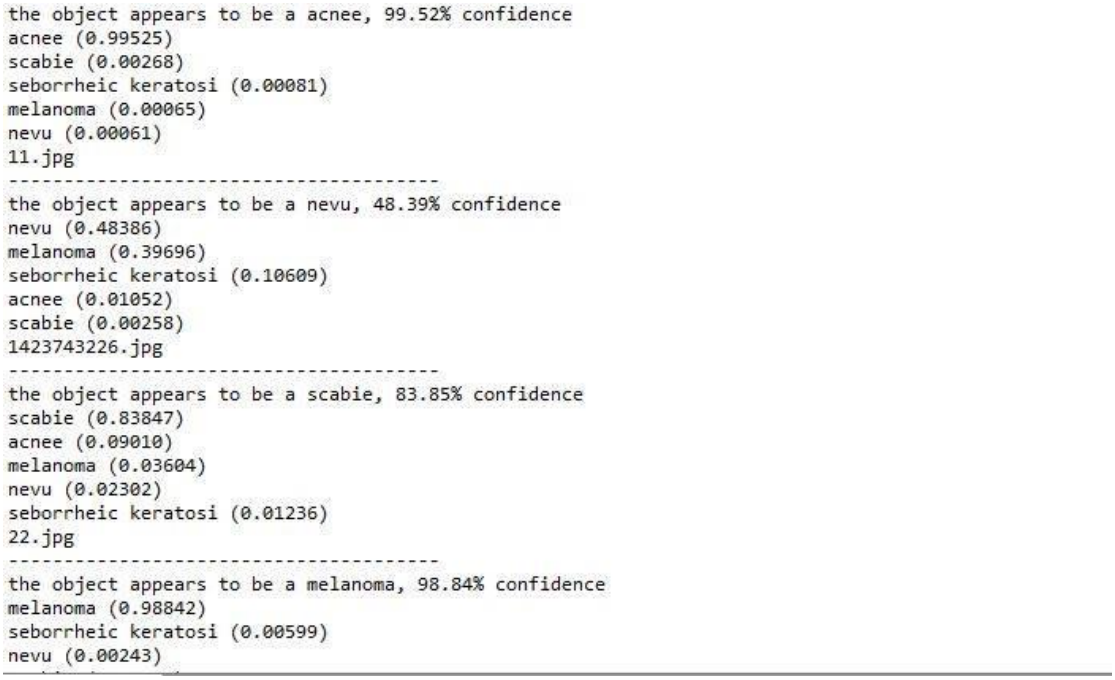

Figure 4.6: After testing the data

4.3 Descriptive Analysis

Inspired by the classical Alex Net, Google Net, and their performance improvements, a deep convolutional neural network model is proposed to identify skin disease detection based. We tried to make this project efficient and accuracy above 90% so that it can recognize image correctly. As we know computer read image data in array. So, some image decoding array are almost same that time the recognizer accuracy below 60%. For this project we have to download this library otherwise this project will not run, such as:

- OpenCV
- CSV
- MATLAB
- TensorFlow

4.4 Summary

The results of this study show that image recognition with transfer learning from the convolutional neural network Inception v3 is a powerful method for high accuracy automated Skin disease detection. This method avoids the complex and labor-intensive step of feature extraction from images in order to train models, and the model can be easily trained on a desktop and deployed on a mobile device. Transfer learning is also capable of applying common machine learning methods by retraining the vectors produced by the trained model on new class data.

CHAPTER 5

CONCLUSION AND IMPLICATION FOR FUTURE RESEARCH

5.1 Summary of the study

The outcome of the research displays that image recognition with transfer learning from the complex neural network inception v3 is a method with great potential with very high accuracy with automated skin disease detection. This procedure removes all the obstacles involving highly complex and labor-intensive steps of data extraction from images to train and develop and accurate models with added benefits that it can be also trained and displayed on a desktop computer and can used in a mobile device such as a smartphone with android OS. transfer learning also comes with the potential to be used in the application of common machine learning method by grasping the vectors developed by the trained model on new class information.

5.2 Conclusions

Skin disease is common problem of our country many people suffer from this disease. By using modern technologies such as Artificial Intelligence and Machine Learning, we can find out such problems quite easily and effectively. There is no better way than providing them a technological service that they can use through their mobile phones. Though the method proposed in this paper focused only on five of the skin diseases shows promising result. The promising result gives us the motivation for future direction for a robust application, making it a more effective tool that all affected people can use for all kind of skin disease. With proper detection of skin diseases, people can know about their diseases on a personal level and thereby encouraging them further to take proper medical attention. A healthier population, working class, friends and family will yield better for the society in the short run and prosper in the long run.

5.3 Recommendations

We have considered few limitations to the system. First drawback of this project is that we have limited background in machine learning study, so understanding the problem or disease was a challenge for us. Another drawback would be the algorithm which cancels the background for image analysis of skin disease has limitations. Because of the unwanted background of the picture, it might not show promising or accurate results. In the initial development of this project we faced many challenges regarding this problem. For the time being we allowed the user to select only on the disease affected options using crop capabilities. However, if the disease occurs in the tip or side of the body, it would be necessary to consider applying background cancellations techniques. In addition, the system is developed in English which will be difficult most of the affected people who' are lived in rural area are not educated enough.

5.4 Implication for Further Study

We have planned to update this system for implementation of the project in real life. We have a plan that upon upgrading this system the affected people who actually living in the remote area of the country will get help easily and can solve their problem with less effort. The primary focus of our project is to overcome the limitations of the current developed system. Our Background cancellation algorithms need to be applied for the image processing to work for any image. In addition to that, we also want to upgrade this system that can detect any skin disease using only mobile phones camera and internet. And our plan to update this system with more accuracy. It can be detecting object as well. We will implement big database and train our image with more information.

APPENDICES

Appendix A: Research Reflection

Target group of Skin diseases

(a) (b) (c) (d) (e)

Figure 5.1: Variety in visual symptoms for different skin disease, (a) melanoma, (b) Acne, (c) scabies, (d) nevus, (e) seborrheic keratosis.

Method of analysis

Visual symptoms in the infected skin region, specially features of the lesion.

Appendix B: Related Issues

Dyshidrotic eczema: This is an irritation of the skin on the palms of the hands and the soles of the feet. It is defined by blisters. Image shown in Figure 5.2.

Figure 5.2: Dyshidrotic eczema

Nummular eczema: It is known as nummular dermatitis or discoid eczema; it is a long-term condition that causes coin-shaped spots to grow on the skin. It produces as circular patches of irritated skin that can be crusted, scaly, and itchy. Image shown in Figure 5.3.

Figure 5.3: Nummular eczema

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