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Improved Mobile Application for Detection of Skin Diseasse using Artificial Neural Network (ANN)

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***Abstract*— As technology advances, the use of mobile technology may be used in the practice and delivery of dermatologic care. Skin diseases are usually more common than other diseases. The presence of skin disease may change texture or color of the skin. We have proposed in this study an improved mobile application model that can detect and diagnose five type of skin disease namely: chicken pox, impetigo, infectious erythema, scabies and skin warts using artificial neural network (ANN). This study used object oriented analysis and design (OOAD) methodology and python programming language. Convolutional neural network with supervised learning algorithm was uses. Different sampling method and preprocessing of input data was explored to further improved the accuracy of the 97%.**

***Keywords*—Component, Mobile Application, Artificial Neural Network, supervised learning.**

I. INTRODUCTION

The Skin is the largest organ of the body, consisting of epidermis, dermis and hypodermis. It protects the internal body tissues from the external environment (i.e skin keeps the body temperature at a constant level, protects our body from undesirable sun radiation such as ultraviolet (UV) light exposure), prevents infections and allows the production of vitamin D, essential for many body functions [15]. The skin has three main functions: auspice, sensation and thermoregulation, providing an excellent aegis against aggression of the environment. It provides elasticity and vigor to the skin [12]. The skin usually suffered from many known and unknown disease which occurs amongst almost all age groups of people. The rate of skin disease has been on the increased due to lifestyle and changing environments [8]. Skin diseases are usually caused by various factors both internal and external such as different organism's cells, diet, and genetic group of cells, hormones, different skin care routine and immune system of conditions. These factors may act together or in a sequence of skin disease. There are chronic and incurable diseases, like eczema, chicken poxpsoriasis, and malignant diseases like malignant melanoma.

However, cures for these diseases are available if they are detected at the early stages [1].

Skin diseases are quite common compared to other diseases. Skin diseases may be caused by fungal infection, bacteria, allergy, viruses, etc. A skin with disease may change in texture or color. In general, skin diseases are chronic, infectious and sometimes may develop into skin cancer. Hence, it is important for skin diseases to be diagnosed early to reduce their development and spread. The diagnosis and treatment of a skin disease takes longer time and causes financial and physical stress to the patient. In general, most people do not know the type and stage of a skin disease. Some of the skin diseases show symptoms several months later, causing the disease to develop and spread faster on the body. This is due to the lack of medical knowledge in the public. Sometimes, a dermatologist (skin specialist doctor) may also find it difficult to diagnose the skin disease and may require expensive laboratory tests to correctly identify the type and stage of the skin disease. But the cost of such diagnosis is still limited and very expensive [11].

Hence, we propose an Artificial Neural Networked aided mobile application to diagnose skin diseases. This method takes the digital image of disease affected skin area then displays the name of the disease to the user. The proposed approach is simple, fast and does not require expensive equipment other than a smartphone

II. AIM AND OBJECTIVES OF THE STUDY

This study is aimed at the design of an improved mobile application for skin disease diagnosis using Artificial Neural Network (Convolutional Neural Network).

i. To determine what makes a skin diseased.
ii. To source for skin disease dataset to train, test and validate using python.
iii. To model a mobile application for skin disease detection.

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III. Literature Review

[6] worked on A Smartphone-Based Skin Disease Classification Using MobileNet CNN. The research achieved 94.4% accuracy in determining the seven skin diseases. Using under sampling method and the default preprocessing of input data achieved an 84.28% accuracy on the test dataset. While, using the imbalanced dataset and the default preprocessing of input data achieved a 93.6% accuracy. Then, the researcher used oversampling and the model attained a 91.8% accuracy. Lastly, using the oversampling and data augmentation technique provide an accuracy of 94.4%. However, they were unable to enhance the accuracy of the model by using different sampling techniques and preprocessing of input data.

[16] proposed a CNN model based on Google's EfficientNet-b4 with pre-trained weights on ImageNet trained by a novel dermoscopic dataset represented the real dermatological clinics environment of a tertiary class hospital in China with 14 categories of common cutaneous diseases. Our CNN model achieved a rather high level of performance, with an overall accuracy of 0.948 ± 0.001 (mean ± SD), a sensitivity of 0.934 ± 0.001 (mean ± SD), and a specificity of 0.950 ± 0.001 (mean ± SD). However, their study lacked the validation of the influences of CNN assistance on dermatologists.

[7] proposed a paper that focused on Machine Learning and Deep Learning based Disease Diagnosis particularly interested in some diseases, such as Heart disease, Breast cancer, Kidney disease, Diabetes, Liver diseases, Malaria disease and Pneumonia disease. Their template was built using tensor flow, Keras and Logical Regression. The total system findings indicate that the MobileNet model functions better than other models and provides improved accuracy in disease detection. However, performance was not taken into consideration as the dataset available was small.

[3] carried a research to identify and categorize the variety of current mobile apps available in dermatology for patients and providers. They identified a variety of dermatology-related Mobile apps and recognize both the potential benefit and inherent risk in their use for the management of skin disease. However, they opined that additional Investigation is required to further elucidate the extent of Mobile app use among dermatologists and patients.

[2] in their work titled "Automatic Detection and Severity Measurement of Eczema Using Image Processing ". They proposed a computer system that automatically detects eczema and determines its severity.

The system consists of three stages, the first effective segmentation by detecting the skin, the second extract a set of features, namely color, texture, borders and third determine the severity of eczema using Support Vector Machine (SVM). However, Lichenification and scratching while calculating eczema intensity score was not included.

[13] proposed a program using image processing to predict and resolve enormous applications. He proposed a system where the system administrator can manage information from a skin disease, symptoms, medical treatment and suggestions and prepared a statement to display the description of the skin disease.

[10] developed an expert system for diagnosis of skin diseases. The system allows user to identify diseases of the human skin to provide advises or medical treatments in a very short time period. The system uses technologies such as image processing and data mining for the diagnosis of the disease of the skin. The image of skin disease is taken and it must be subjected to various processing for noise eliminating and enhancement of image. This image is immediately segmentation of images using threshold values. Finally data mining techniques are used to identify the skin disease and to suggest medical treatments or advice for users. However, the application was only developed for windows application.

[14] in their paper addressed several techniques for skin disease classification and automated the skin disease into category and various deep-domain procedures. However, their work did not cover current advancements in AI and the advantages of AI-assisted diagnosis.

[11] carried out a research on Method of Skin Disease Detection Using Image Processing and Machine Learning. Their approach works on the inputs of a color image. Then resize the image to extract features using pre-trained convolutional neural network. After that classified feature using Multiclass SVM. The system successfully detects 3 different types of skin diseases with an accuracy rate of 100%. However, they were unable to develop a mobile application for this method and their system could only detect 3 kinds of skin diseases.

IV. Artificial Neural Network

Artificial Neural Networks (known as ANNs) are a category of machine learning algorithms whose design has been inspired by the neurophysiological workings of the human brain. ANNs use a mathematical model of a neuron, in which the input nerve impulse (xi) is multiplied by a learnable matrix of weights (wi), that represent the synaptic strengths of neurons.

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The second parameter that the model can learn is called the bias term (b), that is directly added to the elementwise multiplication of previous matrices [4].The mathematical modelof the neuron will fire the output signal (xiwi) according to an activation function (f), which introduces a non-linearity to the equation is shown in figure 1.

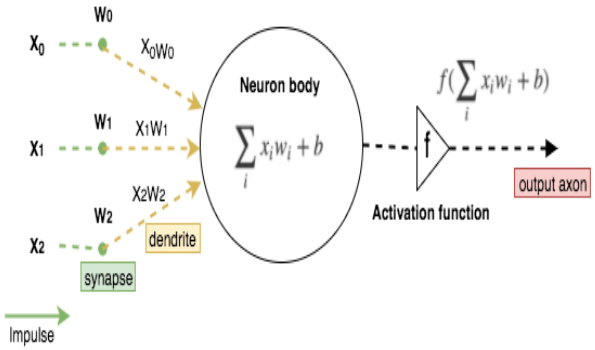

Figure 1: Mathematical model of the biological neuron [4].

Neural Network contain millions of neurons organized into three layers (Figure 2):

a) Input layer (neurons in this layer do not have inputs themselves)

b) Hidden layers, connected to the input layer

c) Output layer (this layer is connected to the hidden layers). The most common layer organization is the Fully-Connected layer, where each neuron is fully paired with adjacent neurons [5].

Figure 2 shows a neural network with six inputs, two hidden layers and one single output.

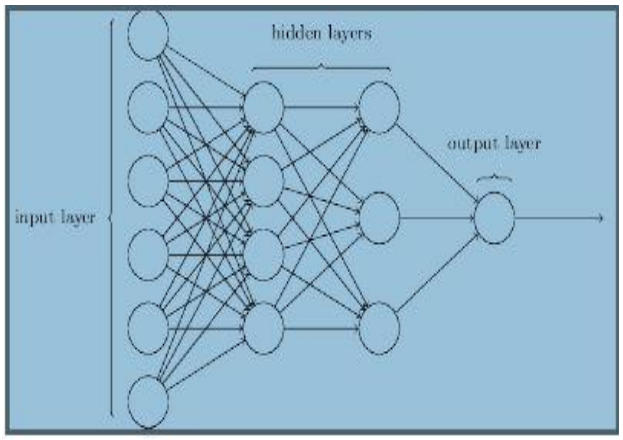

Figure 2: A neural network with six inputs, two hidden layers and one single output [5].

V. Neural Network Architecture

Nowadays, there are several convolutional neural networks architectures that achieved successful results on benchmark challenges such as the Imagenet Large Scale Visual Recognition Challenge. The U-Net was in charge of the semantic segmentation task, the network merges a convolutional network architecture (contracting path on the left side) with a deconvolutional architecture (expansive path on the right side) to obtain the semantic segmentation. The convolutional network is composed of a repetitive pattern. Sample U-Net Architecture (example for 32→32 pixels in the lowest resolution) is shown in figure 3.

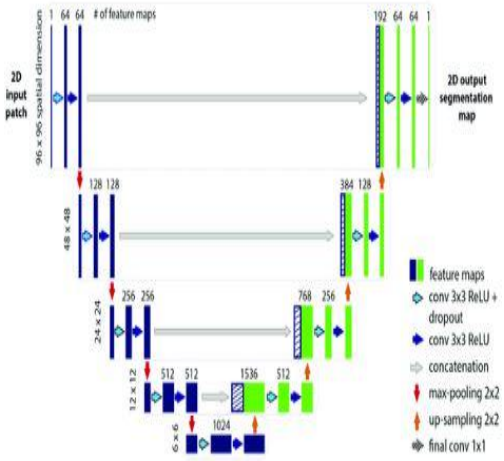

Figure 3: Illustration of the U-net architecture [9].

VI. Methodology

A. *Existing System*

[11] carried out a research on Method of Skin Disease Detection Using Image Processing and Machine Learning. Their approach works on the inputs of a color image, then resize of the image to extract features using pre-trained convolutional neural network and process to classify the feature. The system successfully detects 3 different types (Eczema, melanoma and Psoriasis) of skin diseases using 20 dataset with an accuracy rate of 100%. However, they were unable to develop a mobile application for this method and their system could only detect 3 kinds of skin diseases using a small amount of dataset. Figure 4 shows the existing system architecture.

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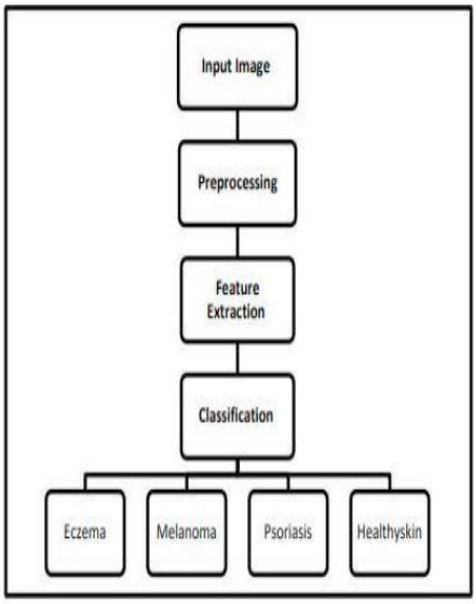

FIGURE 4: Exiting system Architecture [11].

B. Proposed System

The proposed system is a simulated mobile application for the detection of skin disease. The system will provide a precise approach that would determine if skin is infected and the type of infection thereby helping individuals reduce the risk of further skin complications and seek help.

C. Flowchart Of The Proposed System

A flowchart uses diagram to illustrate solution model. In this work, it illustrates the procedures involved in detecting skin disease. The flowchart begins from gathering images of affected skin and healthy skin from expert and ends with diagnosis and classification of the skin disease using neural network. This flowchart shows the internal structure of the proposed system and how it functions. Figure 5 shows the flowchart of the proposed system.

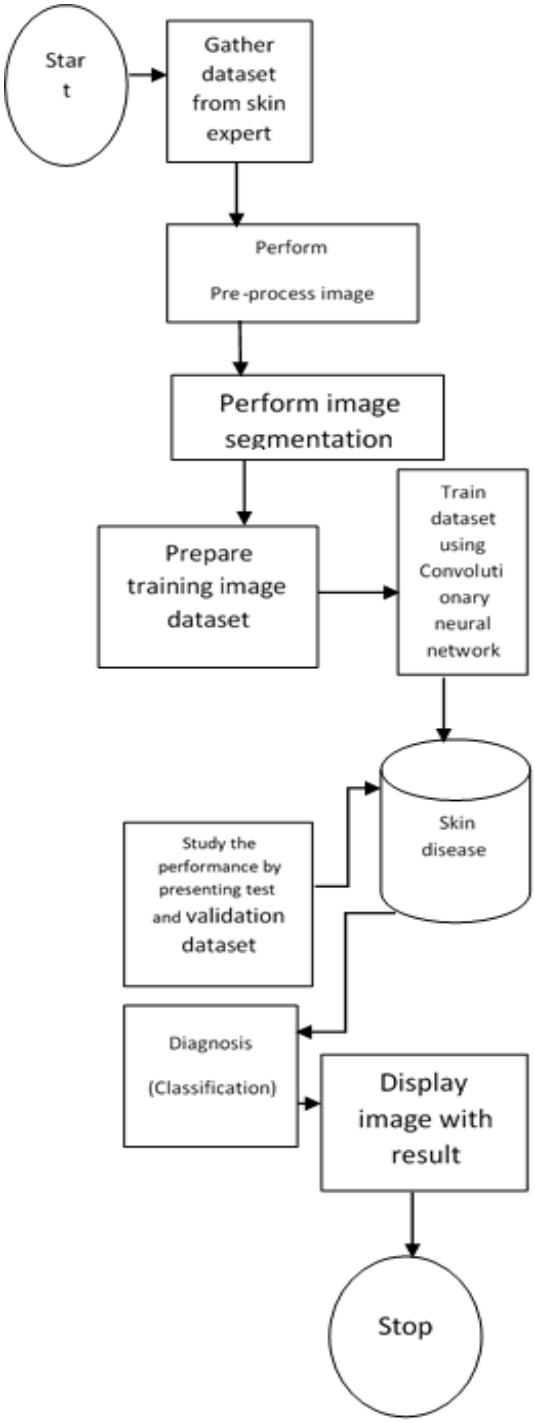

Figure 5: Flowchart of the Proposed System Model

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D. Proposed System Architecture

Train a given percentage of the images gotten from experts and pre-process the images, segment them and after that extracting its features and set images are stored in a database. Test and validate using the remaining dataset to compare the features that extract from the test set image with the feature stored in the knowledge base. The image is then classified using convolutional neural network before diagnosis of the disease is made. When a user uploads an image, it goes through the same processing and use the image in the database to compare the image given by the user and diagnosis the skin disease. Figure 6 shows the system architecture of the proposed system.

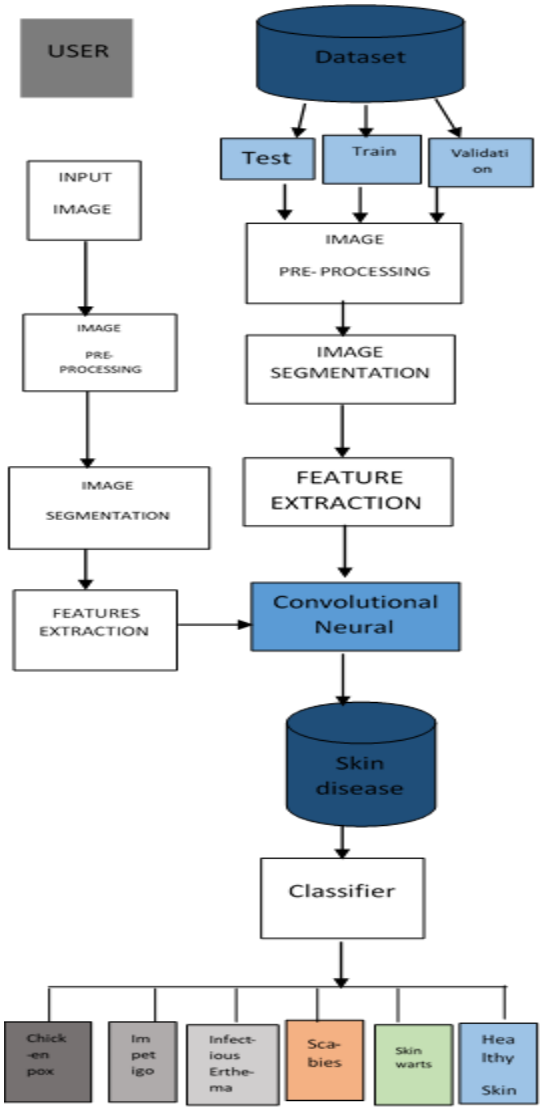

Figure 6: Proposed System Architecture

1. *Input image:* image is inputted from a camera.
2. *Image processing:* this technique manipulates and analyzes the image received from a camera. Its objective is to enhance the skin disease image quality and extract image information to enable proper interpretation of the image.
3. *Image Segmentation:* partitioning the lesion region from the skin. This is achieved based on similarity or difference in pixels properties like color, sharpness, brightness, or intensity of an image.
4. *Feature Extraction:* It uses the segmented lesion to extract the characteristics' features that represent the information of that image to enable image classification.
5. *Skin Disease Database:* contains the trained, tested and validated dataset.
6. *Classifier:* classifies data into different classes using the convolutional learning algorithms to predict the disease. After extraction of features, the extracted features are feed into the classifier model and used to diagnosis the detected skin disease

E. Android Application

The development of a mobile application for skin disease diagnosis using supervised learning through Convolutional Neural Network consist of three processes which include: skin lesion capturing, neural network , and display of the result, Figure 7 shows an illustration of the development of the mobile application for skin disease detection.

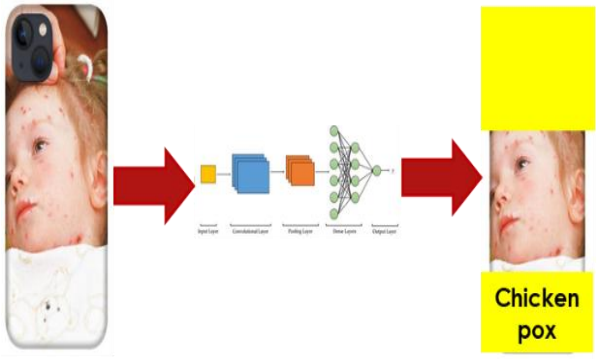

Figure 7: Illustration of the development of the mobile application for skin disease detection

F. Data Collection

Our dataset consists around 512 images which collected from Gifhub and various websites which are dedicated towards skin diseases and its cure to be more accurate and realistic. The data has been divided into three parts, training set, test sets and validation set. 310 dataset were used for training, 112 dataset were used for testing and 90 dataset were used for validation.

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The training set data is used to train our model and the test set is used to check if our model is working good or not. Our dataset is then classified into various parts based upon the types of diseases to be trained for each one of them. Table 1 has detailed description of disease dataset.

Table 1:
Description of Disease Dataset

Disease	Sample Image	Total Image
Chicken pox		67
Impetigo		100
Infectious Erthema		100
Scabies		45
Skin Warts		100
Normal Skin		100

G. Methodology Used In The Proposed System

The methodology used in the proposed system is Object Oriented Analysis and Design (OOAD). Mukherjee (2016) described Object Oriented Analysis and Design (OOAD) model as a software engineering approach that models a system as a group of interacting objects. OOAD is conducted in an iterative and incremental manner. The intention is for these to be continuously refined and evolved, driven by key factors like risks and business value. The object-oriented paradigm emphasizes modularity and reusability. The software life cycle is typically divided into stages going from abstract descriptions of the problem to designs then to code and testing and finally to deployment.

H. Implementation

Python programming language was selected for developing this application as it is an object oriented programing language which is supports construct such as abstraction encapsulation, inheritance and polymorphism. Also in some specific tasks MATLAB was also used.

VII. Discussion Of Result

This model is evaluation using the training and testing partition used for the Github dataset.

The metric used is:

Accuracy: the number of correct predictions divided by the total number of predictions.

Ac = t/N* 100%
t=number of correct predictions
N= number of samples
Ac= accuracy
T= 500 N=512

Therefore:

Ac= 500/512 *100% = 97%.

VIII. Conclusion

Skin Diseases is a very common human illness, but a lot of people still do not consult doctors. We simulated an improved mobile app for skin disease diagnosis to reduce life risk. This research is based on the existing dataset and can identify only five types of skin diseases. Object Oriented Methodology was used and the code was written using python. Future work could involve further testing of segmentation is necessary for classification using deep learning techniques. Also, larger datasets could be used to help determine if and when segmentation does provide a significant performance increase.

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