Bacterial Skin Infection Detection using ANFIS

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Abstract-Skin is the body's first barrier against any infection. Even though many bacteria live on the surface of our skin, healthy skin can usually protect us from infection. Skin infections can occur as a small spot or may spread, affecting a large area which may occur normally or by viruses, bacteria and fungi. Discovering skin illnesses is a critical component of medical science which has the potential to diminish the number of people who suffer as a consequence of skin disease or exposure to infectious. A bacterial infection can be detected using image processing with Adaptive Neuron Fuzzy Interference System more effectively. Bacterial skin infection classification using Adaptive Neuron Fuzzy Inference System classifier involves training a model using a dataset of images of bacterial skin infections and other skin diseases. Hence a model that can accurately predict whether the infection present in the image is a bacterial skin infection or not is developed.

***Key words*—Bacterial skin infection, ANFIS, image processing, MATLAB.**

I.INTRODUCTION

The skin is the body's largest organ, made of water, protein, fats and minerals. Your skin protects your body from germs and regulates body temperature. Nerves in the skin help you feel sensations like hot and cold. The skin covers the entire external surface of the human body and is the principal site of interaction with the surrounding world. It serves as a protective barrier that prevents internal tissues from exposure to trauma, ultraviolet (UV) radiation, temperature extremes, toxins, and bacteria. Other important functions include sensory perception, immunologic surveillance, thermoregulation, and control of insensible fluid loss. The integument consists of 2 mutually dependent layers, the epidermis and dermis, which rest on a fatty subcutaneous layer, the panicles adipose. The epidermis is derived primarily from surface ectoderm but is colonized by pigment-containing melanocytes of neural crest origin, antigen-processing Langerhans cells of bone marrow origin, and pressure-sensing Merkel cells of neural crest origin. The skin protects us from microbes and the elements, helps regulate body temperature, and permits the sensations of touch, heat, and cold. Normally, different types of bacteria live on a person's skin. Cellulites or abscess can occur if there is a cut or a break in the skin that allows bacteria to enter and cause an infection. Skin infections occur when bacteria infect the skin and sometimes the deep tissue beneath the skin. Cellulites is a common type of skin infection that causes redness, swelling, and pain in the infected area of the skin. Another type of skin infection is **skin abscess**, which is a collection of pus under the skin. The advancements in technology and artificial intelligence have brought significant improvements in detecting bacterial skin infection. Image processing techniques have been used to build models that can accurately detect the status of bacterial skin infections. The aim here is to document the development and testing of an algorithm for skin infection detection using image processing techniques. In the first part, building a model to detect the status of bacterial skin infections is involved, while the second part involves the classification of bacterial skin infections. ANFIS algorithm is used in this project to build the detection system. MATLAB is used to monitor the infectious image input from the dataset and feed it into the machine learning model to detect the status of the infection. A machine learning algorithm is applied to the model to evaluate the accuracy of the approach. By accurately detecting bacterial skin infections, early intervention can be provided to patients, and appropriate treatments can be prescribed. This can lead to faster recovery times and better patient outcomes. The use of machine learning algorithms in skin infection detection also has the potential to improve the efficiency and accuracy of diagnosis, which can ultimately lead to better patient care.

II.ASSOCIATED LITERATURE

One of the previous studies states that a skin disease is a particular kind of illness caused by bacteria or an infection. These diseases like Psoriasis, Melanoma, Papilloma's, Mycosis, and Warts etc. have various dangerous effects on the skin and keep on spreading over time. It becomes important to identify these diseases at their initial stage to control it from spreading. These diseases are identified by using many technologies such as image processing, data mining, k nearest neighbor (KNN) etc. Recently, image processing has played a major role in this area of research and has widely used for the detection of skin diseases. Another study states thatnnowadays, people of all ages are suffering from various diseases. Skin cancer is one of the most common problem and it seriously impacts on human life and health. Fungal infection, bacteria, allergy, harmful UV rays of sunburn, etc. may be the reason for various types of skin disease. It can be recover if the disease can diagnose more quickly and correctly in the novel stage. At present, Machine Learning (ML) plays a significant role in the medical field. Yet another study proposes an approach that computes the shape and size features of connected components and use these features for the classification of bacterial and viral tropical skin infections. The performance of the approach is demonstrated using gradient boosting machines and compare the results to deep learning approaches. Results show that the performance of our approach is comparable to that of Convolution Neural Networks (CNN) based approach when trained on 1460 images. Moreover, CNN was pre-trained and required augmentation to achieve that performance. However, our approach is at least 56% faster than CNN.

III.PROPOSED METHODOLOGIES

A. Background of ANFIS

An Adaptive Nero-Fuzzy Inference System or Adaptive Network-Based Fuzzy Inference System (ANFIS) is a kind of artificial neural network that is based on Takagi–Surgeon fuzzy inference system. Since it integrates both neural networks and fuzzy logic principles, it has potential to capture the benefits of both in a single framework. Its inference system corresponds to a set of fuzzy IF–THEN rules that have learning capability to approximate nonlinear functions. Hence, ANFIS is considered to be a universal estimator. For using the ANFIS in a more efficient and optimal way, one can use the best parameters obtained by genetic algorithm. The typical Adaptive Nero-Fuzzy Inference System looks something like the given figure

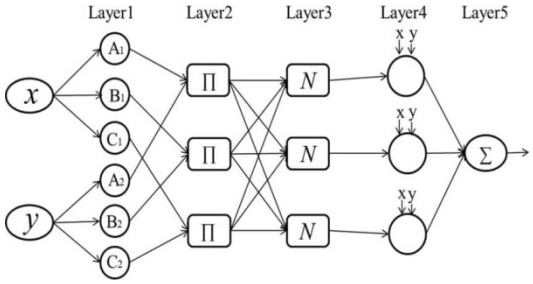

Fig.1 Adaptive Nero-Fuzzy Inference System

B.MATLAB TOOL BOX FUNCTIONS

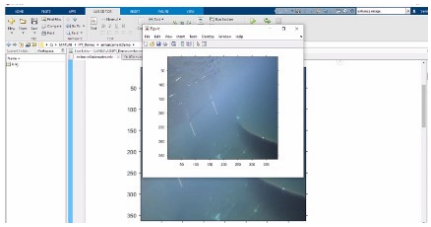

Fig. 2. MATLAB image processing tool box

All the images from the dataset are read as a list of arrays using MATLAB's image processing toolbox. The images are then converted to RGB images using the toolbox's built-in functions.

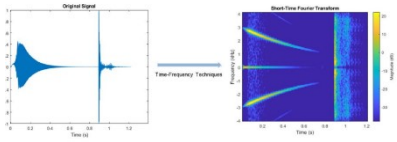

Fig. 3. MATLAB feature extraction

For feature extraction, statistical features including mean, standard deviation, skewers, and kurtosis is used. The statistical features are calculated using MATLAB's image processing toolbox.

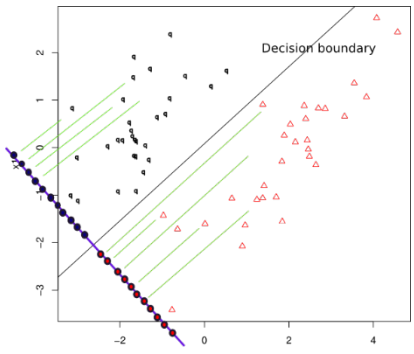

Fig.4.Linear Discriminate Analysis

For feature selection, we used Linear Discriminates Analysis (LDA) to identify the most important features for classification. LDA is a supervised classification technique that aims to find the linear combination of features that maximizes the separation between different classes. The LDA algorithm was applied using MATLAB's Statistics and Machine Learning Toolbox.

IV. PROPOSED MODEL FUNCTIONS

Bacterial skin infection classification using ANFIS (Adaptive Neuron Fuzzy Inference System) classifier involves training a model using a dataset of images of bacterial skin infections and other skin diseases. The goal is to develop a model that can accurately predict whether a given image is showing a bacterial skin infection or not. Here are the main steps involved in the process:

After selecting the features, we used the pre-processed dataset for training and testing an ANFIS classifier. The dataset was divided into a training set and a testing set using a 70:30 split. The ANFIS classifier was created and trained using MATLAB's Fuzzy Logic Toolbox. The training set was used to train the ANFIS classifier, and the testing set was used to evaluate the performance of the model.

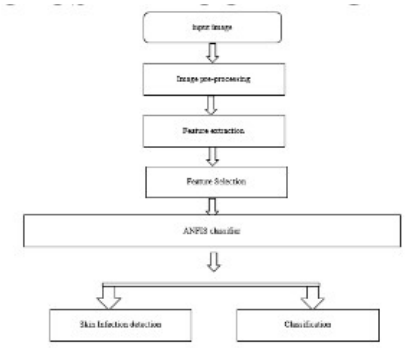

Fig. 2. Proposed system block diagram

1. Load and pre-process the image data: The dataset containing images of bacterial skin infections and other skin diseases is loaded and pre-processed. This involves reading the images as arrays, converting them to greyscale or RGB if needed, and resizing them to a standard size if necessary.

2. Feature extraction: Features are extracted from the pre-processed images using various techniques such as statistical features, texture features, etc. These features are then used as inputs to the ANFIS classifier.

3. Feature selection: Feature selection is an important step in reducing the dimensionality of the feature space and improving the accuracy of the classifier. Techniques such as LDA (Linear Discriminates Analysis) can be used for feature selection.

4. Training the ANFIS classifier: The ANFIS classifier is trained using the pre-processed image data and the selected features. The goal is to optimize the parameters of the ANFIS model so that it can accurately classify bacterial skin infections.

5. Evaluating the ANFIS classifier: Once the ANFIS classifier is trained, it is evaluated using a test set of images that were not used during training. The accuracy of the classifier is calculated based on how well it can predict whether an image is showing a bacterial skin infection or not.

6. Improving the performance: If the performance of the ANFIS classifier is not satisfactory, various techniques such as data augmentation, hyper parameter tuning, or using a different classifier can be applied to improve the performance.

V.PERFORMANCE EVALUATION

ANFIS classifier achieved an accuracy of 98.7% on the testing set. This demonstrates that the selected features and ANFIS classification algorithm were effective in predicting bacterial skin infections and other skin diseases. First, ANFIS models can incorporate both numerical and linguistic knowledge. This means that domain experts can provide input in the form of fuzzy logic rules, which can help the model better understand the underlying patterns in the data. In contrast, CNNs are typically trained through a trial-and-error process and do not incorporate prior knowledge .Second, ANFIS models are often more transparent than CNNs. ANFIS models allow for easier interpretation of the decision-making process and can be more easily inspected to identify how the model is making its decisions. This transparency can be important in fields such as medicine or finance where decisions need to be explained to stakeholders. Third, ANFIS models are less prone to over fitting, which occurs when the model memorizes the training data instead of learning the underlying patterns. This is because ANFIS models use a smaller number of parameters and are less complex than CNNs, which makes them less likely to memorize the data. However, CNNs are still highly effective for image classification tasks and have shown state-of-the-art performance on many benchmark datasets. The choice between using ANFIS or CNNs ultimately depends on the specific task and the available data.

VI.CONCLUSION

In conclusion, the ANFIS classifier can be a powerful tool for bacterial skin infection classification, provided that the data is pre-processed correctly, features are extracted and selected carefully, and the classifier is trained and evaluated thoroughly. The successful use of feature extraction, feature selection, and ANFIS classification techniques for predicting bacterial skin infections and other skin diseases using a dataset collected from Gaggle is demonstrated. Results show that the ANFIS classifier achieved an accuracy of 98.7% on the testing

set. This project can be extended by using a larger dataset or by comparing the performance of different classification techniques.

VII.FUTURE WORK

The future work can be done by extending a larger dataset or by comparing the performance of different classification techniques.Further development of the proposed model can be done with an architecture that advances ANFIS that can include various dimensions and help with the accuracy even better.

REFERENCES

[1] "Machine Learning and Deep Learning Integration for Skin Diseases Prediction", Samir Kumar Bandyopadhyay , PayPal Bose , Amiya Baume , Sandeep Plodder - 2022

[2] C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011.

[3] "Detection and Classification of Skin Diseases using Different Color Phase Models, A.V.Ubale1, P.L. Paikrao2– 2019

[4] C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011.

[5] "Evaluating and Enhancing the Performance of Skin Disease Classification Based on Ensemble Methods" MituPal, Bristi Rani Roy. -2020

[6] Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.

[7] "Skin Disease Classification from Image - A Survey ", TanviGoswami , Vipul K. Dabhi, Harshadkumar B. Prajapati – 2020

[8] "Tropical Skin Disease Classification using Connected Attribute Filters " Fred N. Kiwanuka1 , Omar Eltaher Abuelmaatti1 , AnangHudaya Muhamad Amin1 and Brian J. Mukwaya2– 2021

[9] "Melanoma Detection by Analysis of Clinical Images Using Convolutional Neural Network" E. Nasr-Esfahani, S. Samavi, N. Karimi, S.M.R. Soroushmehr, M.H. Jafari, K. Ward, K. Najarian "Detection and Classification of Skin Diseases using Different Color Phase Models" A.V.Ubale1, P.L. Paikrao International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 07 | July 2019

[10] ""Skin disease detection using computer vision and machine learning technique",Leelavathy S, Jaichandran R, Shobana R, Vasudevan, Sreejith S Prasad and Nihad,European Journal of Molecular & Clinical Medicine ISSN 2515-8260 Volume 7, Issue 4, 2020

[11] C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of ELECTRICAL ENGINEERING, Vol.63 (6), pp.365-372, Dec.2012.