A Study on Dermatological Diseases Using Classification Approaches

G.Kavitha[1], Dr.K.Vanitha[2]
[1]Assistant Professor, Dept of Computer Science
[2]Associate Professor, Dept of Computer Science
[1]Dr.N.G.P. Arts and Science College (Autonomous), Coimbatore, Tamilnadu, India.
[2]Dr G R Damodaran College of Science (Autonomous), Coimbatore, Tamilnadu, India.

Abstract- *Machine learning algorithms are widely used in medicine. Breast cancer, kidney illness, thyroid disease, diabetes, cancer, erythemato-squamous diseases, and a variety of other ailments all can benefit from these machine algorithms. The erythemato-squamous diseases (ESD) are used for the subject of this study. The main issue is that only a trained dermatologist is capable of detecting and classifying such diseases. To classify ESD Various classification algorithms were applied specifically VF15, C4.5, SVM, KNN, Neural Networks, Ensemble classifier algorithms like random Forest, Gradient Boosting Machine, Boosting, Artificial Neural Network, Deep Learning, Fuzzy Neural Networks, Ensembling learning using deep learning, Convolutional Neural Networks (convNet) and many are used. Another approach is feature selection which is applied with these classification algorithms to obtain the finest accuracy. It is experimented that, Ensemble classifier algorithms, feed forward Neural Network, Random Forests, convNet and Derm2Vec are giving best training precision for the exact classification of skin diseases among all preferred.*

Keywords- Dermatological Diseases, Deep Learning, Erythemato-Squamous Disease, Ensemble Classifier Algorithms, Fuzzy Neural Network, Machine Learning.

I. INTRODUCTION

The skin is the most significant part of human body and its affecting a high proportion of the population in India. The skin protects the body from UV radiation infections, injuries, heat and harmful radiation, and also aids in the manufacture of vitamin D. More recently, there has been widespread acknowledgment that skin diseases can affect physical, social and psychological aspects of patients everyday lives the skin plays an important role in controlling body temperature, so it is important to maintain good health and protect the body from skin diseases. The fast development of computer technology in present decades, the use of data mining technology plays a crucial role in the analysis of skin diseases to do services. There are plenty of skin related diseases are exist like erythemato-squamous (ESD) disease and other preliminary skin diseases. The identification and diagnosis of ESD is difficult, because all the classes contribute to the same clinical properties scaling and erythema with few changes. The different classes of ESD are C1:psoriasis, C2: seborrheic dermatitis, C3: lichen planus, C4: pityriasis rosea, C5: chronic dermatitis, and C6: pityriasis rubra. To diagnose ESD and other illness, there were plenty of several methods proposed which includes VF15, SVM, C4.5, KNN, Neural Networks,Ensemble classifier algorithms like random Forest, Gradient Boosting Machine, Boosting, Adaboosting, Fuzzy logic, Deep learning, Fuzzy neural networks ,Ensembling learning with deep learning, Convolutional Neural Networks, several base classifiers are generated and combined into a single classifier, and hybrid feature selection techniques. Sometimes two stage strategy that merged with Computer Vision and Machine Learning to diagnose diseases. These algorithms now assist the doctors for finding to diagnose better. The literature is replete with above stated models even though some of the models can be implemented for further research like Random Forest can be combined with dimensionality reduction Flexible Discriminant Analysis, Mixture Discriminant Analysis, Multidimensional scaling and so on methods, to diagnosis of the skin illness. The objectives of this study is to find out the all the work related to the diagnosis of ESD and various other skin disorders which can be particularly used in the machine learning algorithms. The review is starting from 1998 to till date. Various studies have been done in this field and it's discussed below.

II. LITERATURE SURVEY

The following are the existing works on classification and prediction of medical datasets carried out on the dermatology data set from UCI Repository and other resources

The first work on the differential diagnosis of erythemato-squamous diseases is that of [1] where the authors developed a new classifier called "Voting feature intervals-5" with accuracy of 96.2% for the differential diagnosis of ESD in 1998. It has short training and classification times and the algorithm proved the robustness in noisy training instances

and missing feature values. [2] Incorporated three classification algorithms specifically, Voting feature intervals-5, Na¨ıve Bayes and nearest neighbor classification of with accuracy of 99.2% for diagnosis of the type of Erythemato-Squamous Diseases at 2000.

[3] Bojarczuka CC et al., developed system with the help of genetic Programming and c4.5 algorithm later GP was compared with C4.5.They obtained 96.64 and 89.12 % accuracies Overall, the rule set discovered by the GP was shorter than the rule sets discovered C4.5.[6] Kemal Polat et al. used a hybrid classification system, Initially based on C4.5 decision tree classifier and c4.5 cross folded with one-against-all approach . In this method 84.48 and 96.71% classification accuracies were achieved in 2009. In order to compare the accuracy of both methods hence C4.5 gave the better results in the Classification process. In future, C4.5 decision tree classifier can be integrated with the other classifier algorithms such as Bayesian learning, Artificial Immune System algorithms and Artificial Neural Networks.[25] O. C. Abikoye et al. in this research, mainly concentrated on three different feature selection approaches were implemented they are Principal Component Analysis (PCA), Information Gain (GA) and Chi-square later by three classification algorithm were used such as Random Forest, C4.5 Decision Trees and Functional Tree (FT) to classify the Erythemato-Squamous Diseases. The experimental result showed that 96.72, 96.99 and 93.99% from feature selection using PCA with Functional tree (FT), Random Forest and C4.5 Decision Trees. Besides the study also observed that, not to improve accuracy or sensitivity significantly when using PCA with c4.5.Moreover , it also detected that the time taken to build the model and classify when feature selection algorithms compared with Random forest and Functional Tree.

[4,8,19] [4]Ubeyli and Guler's et al. developed Adaptive Neuro-Fuzzy Inference System (ANFIS) model.It is combined the neural network adaptive capabilities and the fuzzy logic qualitative approach. To perceive about Neuro-fuzzy systems are fuzzy systems which use artificial neural networks theory in order to determine their properties by processing data samples. The specific approach in Neuro-Fuzzy development is the ANFIS, used for Feature extraction .The repercussion of the study is 95.5% which was greater than that of the stand-alone neural network model.Ref.[8] presented a study of semi-supervised evolving fuzzy classification on the diagnostics for two well known medical problems such as Pima Indians diabetes and dermatological diseases. A machine learning method is used in order to predict the class labels on the basis of discrete numerical features and to mine the knowledge (rule) base of the system. The improved eClass models outperformed all the other incremental classification methods (Random Forests,SVM,iPCA). Future work focused on reducing the complexity of eClass.Ref.[19] John Bush Idoko et al. Investigated the capability of the fuzzy Neural Network (FNN) classifier algorithms for the diagnosis of erythemato-squamous diseases. FNN is integrated the Neural network and Fuzzy logic. One of the most convenient and easy methods for mapping an input space to the corresponding output space is the fuzzy logic. The mapping is achieved using the if–then rule with both the antecedent and consequent parts During simulation, the input data were normalized and scaled in intervals of 0–1 (27-34). The normalization of input data allowed quick training for the input–output data and helped to decrease the training time. After normalization, these data were utilized as FNN classifier input signals. As noted, the clustering technique was used for feature extraction. Using these features, the learning of FNN was performed. To implement classification, the input data set was grouped according to the output clusters and the accuracy were 98.37% for 32 rules. Taken together, we conclude that our proposed classifier could be applied for classifying erythemato-squamous diseases due to its high performance accuracy. The further research in fuzzy systems such as type-2 and Z-number would be considered on the same domain.

Ref. [5] Authors used a new ensemble of LSVMs based on Random Space and feature selection. The classifiers in the ensemble can be built on different subsets of features, either disjoint or overlapping. The Feature selection aims at a more efficient computation and a higher accuracy of the ensemble. It is believed that classifiers based on different features offer complementary information about the patterns to be classified. Their results improved the average predictive accuracy obtained by a ''stand-alone'' SVM or by a RS ensemble of SVMs.

Ref.[7] Elif Derya Übeyli demonstrated the combined Neural Networks (CNNs) model to develop model selection for diagnosis of the erythemato-squamous diseases. For the purpose of build CNN to diagnosis the erythemato-squamous diseases, for the first level models six sets of neural networks were used since there were six possible outcomes of the diagnosis of erythemato-squamous diseases. Furthermore, the multilayer perceptron neural networks (MLPNNs) were also tested and benchmarked for their performance on the diagnosis of the erythemato-squamous diseases. The accuracy rates achieved by the CNN were 97.77% found to be higher than that of the stand-alone neural network model.

Ref.[24,27,29,31] In these papers diverse machine learning algorithms and ConvNet to classify the exact skin diseases based on different image datasets. In first paper,

authors worked on Random Forest, Naive bayes, Logistic regression, Kernel SVM and ConvNet to classify three kinds of skin diseases called acne, lichen planus and sjs ten. Among these models, it is revealed that CNN is giving the best training and testing accuracy of 99.05 % and 96 % respectively and the lowest error rate is 0.04. [27] Jayashree Hajgude et al. worked on detecting three skin diseases particularly melanoma, eczema, impetigo using Image Processing with SVM classifier and Convolutional Neural Networks (ConvNet) classifier. The Comparison between ConvNet and SVM Classifier is done with the help of the confusion matrix. The experimental result is 99.1% in ConvNet which is greater than SVM.

Ref. [29], Authors used 938 images to Classify the three types of Skin diseases expressly Melanoma (439 Images), Nevus (551 Images) and Seborrheic keratosis (413 Images). test growing and a broader part of machine learning family. [32] Deep learning uses Convolutional Neural Networks (ConvNet) for image classification and to extract features from images. A CNN has Convolutional layers, ReLU layers, pooling layers and fully connected layer. ConvNet has various pre-trained architecture like AlexNet, GoogleNet, DenseNet, SqueezeNet, ResNet, VGGNet etc. The study used the ConvNet and AlexNet architecture for diagnosis the diseases present in images. The final inference made from ConvNet algorithms and AlexNet, 70% and 80% accuracy is achieved in assortment of skin diseases respectively. It is concluded from results that accuracy achieved from AlexNet is higher than ConvNet architecture. Apart from ConvNet and AlexNet, for further research work, other architectures may also be developed to improve the accuracy of classification. In this work the skin images are taken from public datasets, which includes AtlasDerm,DermlS, the ISIC Archive, Derm101 and Dermnet.[31] Padmavathi S et al. proposed approaches such as Convolutional neural networks (ConvNet) and Residual Neural Networks (ResNet) to predict skin diseases and dataset consists of 10015 dermatoscopic images categorized into 7 different classes.ConvNet is a deep learning algorithm used for analyzing visual imagery that can accept an input image and attaches some significance to each point in the image which makes is easy to differentiate the points.CNN techniques are well known for its better performance in image recognition. It provides more accuracy of 77% and 68% respectively. Here also found that ConvNet acts well compared to ResNet.The future enhancement is to design a hierarchical classification algorithm to improve the accuracy.

[9] Xie and Wang proposed model based on SVM and improved F-score and Sequential Forward Search (IFSFS) which is a amalgamation of filter and wrapper methods to select the optimal feature subset to diagnosis the ESD. The experimental results achieve 98.61% classification accuracy along with 21 features.Ref.[12] Authors developed two different types of classification approaches such as SVM and sparse representation based on on-line dictionary learning (ODL) on the 5 standard UCI medical datasets. There are three different phases of the proposed classification system followed, namely Feature extraction, sparse coding based on ODL 3. When SVM was compared to existing single and multiple classification algorithms, SVM outperformed them both by 98 percent.Ref.[14] In this paper, Detailed comparative studies were carried between extreme learning machine (ELM) and SVM .The ELM learning algorithm suitable for single hidden-layer feed forward neural network provides better performance. As stated that,the experimental result here also indicated that ELM outperformed SVM. Ref. [17] S. Reena Parvin et al. in their study used 80 images from AOCD unit database and MIT unit database and These images were pre-processed using Gaussian Filter technique and then segmentation process applied by using K-means clustering algorithm to partitioning the disease affected area and non-affected area. Feature extraction was performed by Grey Level Co-occurrence Matrix Gaussian filtering was used to remove the noise and multi-SVM classifier was modelled. Later the performance analysis compared three algorithms such as Multi-SVM classifier, K-NN and Naïve Bayesian classifier. The overall accuracy of using Multi-SVM classifier is 97% to 98%.

[10]H. M. Mashaly et al. used K-means clustering, rough sets, topological derivative (TD), watershed, segmentation, and feature extraction followed by classification. Among these rough set approach provided the better performance results with 93.3%.

[11] The authors created an Artificial Neural Network (ANN) model that correctly classified ESD with a 98% accuracy rate. The multivariable classification problem and successive architectures can be solved using a generalized feed forward neural network (FFNN). FFNN was compared to MLP NN, RBF NN, Modular NN, SVM, and Recurrent NN. FFNN is thought to be the best classifier.

Ref.[13] Concentrated on main ensemble learning strategies include random forests and boosting. The experimental results showed that the random forests classifier outperformed. Some models based on SVM and ANN remain the best models in terms of accuracy, The main focus of future research work would be on increasing the understandability of the learned ensemble of trees (or rules) by reducing their number without affecting too much the classification accuracy for example eliminating equivalent rules, replacing set of rules by more general rules and so on. Investigation of various

ensemble procedures, such as rotation forest and the combination of boosting and bagging, could be another study topic. [22] Anurag Kumar Verma et al. developed five different classification methods namely (i) Classification and Regression Trees (CART) (ii) Support Vector Machines (SVMs),Decision Trees (DTs), (iv) Random Forest (RFs) and Gradient Boosting Decision Trees (GBDTs) were used.Where all five methods collectively were applied, and it results with highest obtained accuracy is 98.64 %.The finest accuracy found among these different techniques is 95.90% from GBDT.[23] Authors, Conducted and compared two experiments differently by using three ensemble methods Bagging, AdaBoost and Gradient Boosting on six different classification algorithms specifically Passive Aggressive Classifier , Linear Discriminant Analysis, Radius Neighbors Classifier, Bernoulli Naïve Bayesian, Gaussian Naïve Bayesian and Extra Tree Classifier and the second using a feature selection method with 15 attributes. The highest accuracy were from this experiment was 99.68% with 15 attributes in the case of the Gradient Boosting classifier applied on RNC. It is advised that ensemble method is Random Forest can be combined with dimensionality reduction Flexible Discriminant Analysis, Mixture Discriminant Analysis , Multidimensional scaling and others can be used. [26]This study has used 3 feature selection techniques univariate feature selection, feature importance, and correlation matrix with heat map to obtain the best featured data subset. Four machine learning techniques NB, DT, SVM, and RF were used on reduced data subset. The best accuracy has found among these different techniques is 97.29% by SVM and calculated the different performance metrics like mean value, standard deviation, root mean square error (RMSE), kappa statistic error (KSE), and area under receiver operating characteristics (AUC). These four machine learning approaches were combined using a stacking ensemble method. The correlation matrix has a maximum accuracy of 99.86 percent when using heat map feature selection processes. Also, the correlation coefficient derived using a heat map is recognized as one of the finest feature selection strategies.

Ref.[15] Presented a new hybrid model for attribute selection based on entropy evaluation, mean evaluation and threshold evaluation after attribute selection FSM like forward selection and backward elimination approach to select the different subset of attributes.

[16] Used a two stage strategy that merged with s Computer Vision and Machine Learning to diagnose diseases.[18] Implemented the Nearest Neighbor classifier using hue saturation value to identify skin disease.[20] Used image processing and machine learning technology to detect diseases using keras in python and to download images urllib2 and wget modules were used. [28] Bisakh et al. introduced dataset augmentation using Generative Adversarial Network (GAN) of three skin diseases like Leprosy, Tinea versicolor, and Vitiligo. The below processed were followed i) dataset preprocessing ii) new sample generation.iii.image classification. With data augmentation, and achieved maximum 94.25% recognition accuracy using DensenNet-121, which was 10.95% better than when no augmentation was employed.

[21] Researchers were employed Deep Learning algorithms to forecast skin illnesses by the researchers. It has been discovered that by combining ensembling characteristics and deep learning produced with 88% of accuracy rate. Subsequent research could be extended to make this model a standard procedure for preliminary skin disease diagnosis which will speed up treatment and diagnosis. [30] Sayan Putatunda, applied a novel hybrid deep learning approach called Derm2Vec and Deep Neural Network. It is originated from artificial neural networks. ANNs with many hidden layers is known as DNNs the Derm2Vec method is found to be the best performer followed by DNN and Extreme Gradient Boosting. The mean CV score of Derm2Vec and DNN were 96:92% and 96:65%.

III.CONCLUSION

There are numerous methods for classifying the erythemato-squamous skin disorders and it has been studied and discussed. The furtherance of artificial intelligence has aided in the advancement of skin disease classification techniques. Based on the above studies, it is discovered that Ensemble classifier algorithms, feed forward Neural Network, Random Forests, convNet and Derm2Vec mostly used and it results with high accuracy. The hybrid of Bagging, AdaBoost and Gradient Boosting on six different classification algorithms specifically PAC, LDA, RNC, BNB, NB and ETC and the second using a feature selection method gave better accuracy. Furthermore, the two-stage technique is used to reliably detect the illness by combining Computer Vision and Machine Learning on clinically determined histopathological features. The correlation coefficient utilizing heat map which is one of the most effective feature selection methodologies. Future work could be expanded in this field to include rotation forest and the combination of boosting and bagging, as well as Random Forest mixed with Dimensionality Reduction Flexible Discriminant Analysis, Mixture Discriminant Analysis, Multidimensional and others. So that the diagnosis skin disease diagnosis and treatment time is reduced.

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