Expert System For Diagnosis Of Skin Diseases

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Abstract: Dermatology is a one of major session of medicine that concerned with the diagnosis and treatment of skin diseases. Skin diseases are the most common form of disease in humans. Recently, many of researchers have advocated and developed the imaging of human vision or in the loop approach to visual object recognition. This research paper presents a development of a skin diseases diagnosis system which allows user to identify diseases of the human skin and to provide advises or medical treatments in   a very short time period. For this purpose, user will have to upload an image of skin disease to our system and answer questions based on their skin condition or symptoms. It will be used to detect diseases of the skin and offer a treatment recommendation. This 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 preprocessing for noise eliminating and enhancement of the 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. This expert system exhibits disease identification accuracy of 85% for Eczema, 95% for Impetigo and 85% for Melanoma.

Index Terms: skin disease diagnosis, expert system, image processing, data mining, eczema, impetigo, melanoma, multilayer perceptron

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I. INTRODUCTION
Skin diseases in Sri Lanka tend to be prevalent due to climatic as well as the living situation of the vast majority of people. Skin disease doesn't just affectthe skin. It can have a huge impact on a person's day-to-day life, crush self-confidence, restrict their movement, and lead to depression and even ruin relationships. So it is needed to take skin disease seriously. As some examples for terrible skin diseases in the country Eczema, Urticaria, Impetigo, Melanoma-skin cancer can be introduced. Today, almost all the sectors and in other fields get the aid of computerized systems. In the field of medical science there is a great demand for computer-aided tools to facilitate many tasks. Many things that were done manually using traditional equipment have been replaced with automated systems. Modern medical science is looking for solution which could assist the doctors with any aspect of work using the new technology. One of the common approaches used in this areas are digital Image processing and Data mining. Our proposed system enables user to recognize skin diseases and provide user advises or treatments in a shorter time period.

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II. PROBLEM IN BRIEF
Skin diseases are common to everyone and different types of allergies are becoming more and more common. Many of these diseases are very dangerous, particularly if not treated at an early stage. Human habits tend to assume that some skin diseases are not serious problems. Sometimes, most of the people try to treat these infections of the skin using their own method. However, if these treatments are not suitable for that particular skin problem then it would make it worse. And also sometimes they may not be aware of the dangerousness of their skin diseases, for instance skin cancers. Skin diseases tend to pass on from one person to another very easily and therefore it is important to control it at initial stages to prevent it from spreading. Also damage done to the skin through skin diseases could damage the mental confidence and well-being of people. Therefore this has become a huge problem among people and it has become a crucial thing to treat these skin diseases properly at the initial stages itself to prevent serious damage. Our system would help address this problem to a great extent since it would allow users to recognize skin diseases and provide advises or treatments for it in a shorter time period by making use of images of the diseased area and by obtaining information from the patient. This would make the treatment of skin diseases convenient hence motivating the people to address these problems at the initial stages.

III. RELATED WORK
Looking into the current situations of computerized skin disease diagnosis systems, there are few solutions available which are still under research developments. Certain limitations and drawbacks are identified in those hence this solution tries overcome the existing problems with different approach. [1] [2] [3]

- *Online Children Skin Diseases Diagnosis System [1]*

This system used rule based and forward chaining inference engine approach to identify the disease of the skin. With this system, it will enable user to identify children skin diseases via online and provide useful medical suggestions or advice. In this system, it consists of diagnosis module, login module, info module, report module and management module. Here there are two main modules called diagnosis and management module.

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Children's symptoms and condition are identified through the set of question given by the system in the diagnose module. This system may be an alternative for parents to identify skin disease of children, in response to the questions about the symptoms and the condition children's skin.

- *Image-based diagnosis method [2]*

This system mainly focuses on diagnosing diseases of skin that are occurred by viruses and bacteria. This system used image of the diverse area and those images are taken and then machine learning techniques and image processing applied to train the computer to diagnose the skin disease.This is an optional diagnosis method for these skin diseases andit is safe and no risks, side effects or inconveniences from the patient perspective. It also gives advantageous to doctors because it is fast and can be implemented in various ways (mobile phones, computers and digital cameras). And also it can be safely used by non-specialized medical personnel.First, the patients were clinically analyzed by a professional (dermatologist/medical doctor), then laboratory tests were conducted to foresee and confirm the skin disorder. The doctor then apprehended some images from the patients whose results showed that they had a viral or bacterial infection.

- *An automated system for recognizing disease conditions of human skin [3]*

In this approach, the condition of the skin disease is identified by analyzing skin disease images with the help of a set of grey normalized symmetrical simultaneous occurrence stencils (GLCM). The proposed system be used be used, in an efficient and economical for the automatic recognition of skin diseases. And also this system is useful for the skin to reduce the error with medical diagnosis. Another is the first test for patients in rural areas, where the good doctors are missing. The system works with relational databases to the storage of implying the need for textual skin images. And also this system can store and search for similar images directly over feature vectors.

TABLE I. COMPARISON BETWEEN SIMILAR APPROACHES

	A	B	C	D
Reliability	Low	High	Medium	High
Speed	High	High	Medium	Medium
User Friendliness	Low	High	Medium	High
Scale	Low	Medium	Medium	Medium
Output detail	Very clear	Not clear	Clear	Clear
Used method(s)	Rule based	Image processing	Image processing	Image processing, Rule based

- A- Online Children Skin Diseases Diagnosis System
- B- Image-based diagnosis method
- C- An automated system for recognizing disease conditions of human skin
- D- Our System

IV. OUR APPROACH

To solve the above-discussed problem we came up with the solution of an Expert System for diagnosis the skin disease. In our solution we need to take care of that difference of pattern. Before examine the patterns the system first need to bring all the images to a certain level where the patterns are much more visible for the usage without noisy and unwanted data then we extract the certain features like area features color features that can be used for create the classification model. With this classification model system finally can predict the disease for a new image of a skin disease. And again based on these predicted disease system will ask question form the user and based on answer system will decide disease type and it is condition with again used of the data mining technique. Finally our system suggests medical treatment or the advice based on out predicted skin disease result.

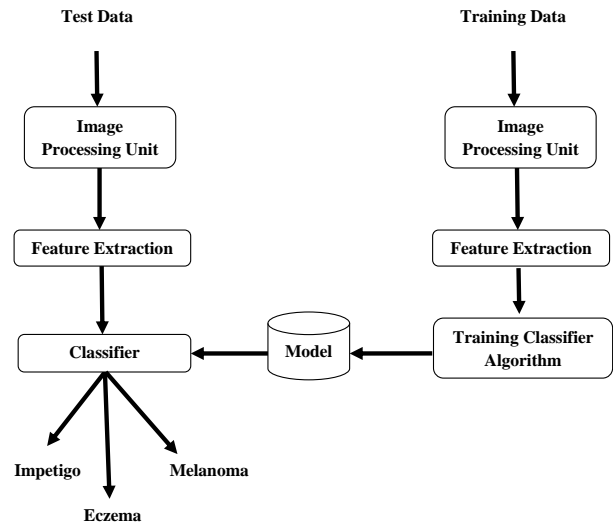*Figure 1 illustrates top level architecture of the proposed solution.*

Figure 1 Top Level Architecture of the System

This research project discussed lot of researching in image processing and data mining for figure outing what are the most efficient and accurate ways of using the novel techniques to provide a better solution for skin disease identification and diagnosis. We started our research based project with a master plan. So according to our plan we divided the whole project in to below major parts,

- ➢ Image preprocessing, segmentation and feature extraction.
- ➢ Classification model and skin disease predication.
- ➢ Medical treatment suggestions or advice.

V. DESIGN OF THE SYSTEM

Our proposedexpert system mainly consists of following components;
- A. Image processing unit.
- B. Data mining unit

A. Image processing unit

Image processing is the main part of the design process in our expert system. Initially it is required to identify the region of skin infected with the disease and in order to do

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that the image processing part of this process should be carried out. The imageof the skin disease should be captured and saved to eliminatenoises in the form of hairs, bubbles etc. with the help of average filtering and Gaussian smoothing process. Algorithms are used in the image segmentation process to remove the background of the image. It means we separate the region of the disease. Then we will be done with the image segmentation of the image. Feature extraction will be carried out and then the extracted featureswill be sent to data mining unit to diagnose the disease. Figure 2 shows that the flow of the Image processing unit.
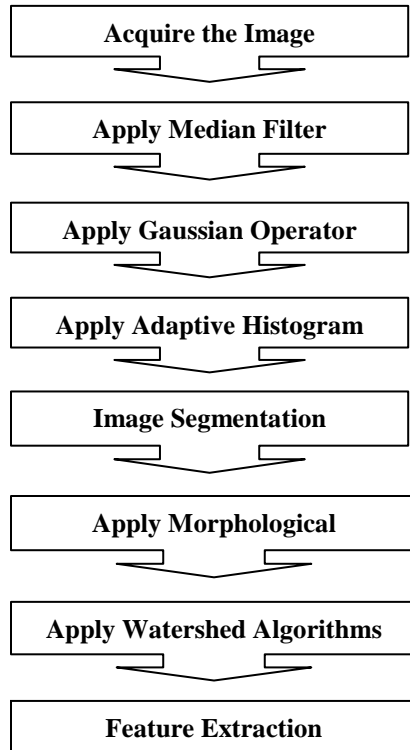
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┌─────────────────────────────┐
│     Acquire the Image       │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│     Apply Median Filter     │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│   Apply Gaussian Operator   │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│  Apply Adaptive Histogram   │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│     Image Segmentation      │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│     Apply Morphological     │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│  Apply Watershed Algorithms │
└─────────────────────────────┘
              │
┌─────────────────────────────┐
│     Feature Extraction      │
└─────────────────────────────┘
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Figure 2 *Process in Image processing unit*

B. Data mining unit

The features obtained from the image processing unit will be examined and the disease will be identified and displayed by this unit. Then some questions such as age, gender, affected areas in the body, how long it was infected etc. will be asked from the user. It is called questionnaire inputs of the systemand will be really helpful to get details about the diseases. Then based on those images extracted features and input for the questionnaire used for creating classification model. Here as the classification model, we have used five different data mining classification algorithms (AdaBoost, BayesNet, J48, MLP and NaiveBayes) and based on the result best classifier is selected. Finally using this data mining classification model, our expert system will the diagnosedskin disease and predicted skin disease and medical treatment suggestionwill be displayed for the user.

VI. IMPLEMENTATION

Implementation of the proposed solution according to each module varied according to different technologies used.

A. Image processing unit

The Dermoscopic Images or digital images that taken from normal camera, are usually contains noises such as hair, air bubbles etc. These noises may leads to inaccuracy of the classification and system will give the wrong predication result. In order to avoid that, images are exposed to various image processing techniques. Image processing contains techniques like image preprocessing and post processing. Preprocessing is done to removes the background noises such as hair and air bubbles and other noises in the skin disease image. To eliminating those noises from the particular skin image and to get smoothing image, median filtering and Gaussian is used. Median filtering is a one of common step in image processing for smoothing the image. Median filtering is used for reducing the effect of small organizations like thin hairs and also remote islands of pixels like air bubbles. Post processing is applied to improve the shape and edges of skin disease image. Apart from that, contrast improvement can improve the image border and enhance the accuracy of the expert system. Then we applied image segmentation helps separate the skin disease form the healthy skin. To separate the healthy skin from disease here we have used concept called thresholding segmentation in image processing. Then we used Morphological transformations for eliminating similar type objects. It is normally performed on binary images. It needs two inputs, one is our original image, and second one is called structuring element **or** kernelwhich decides the nature of operation. Then watershed is used for to identify the disease area of the skin and finally we extracted features (Color and shape features) of skin disease image. Here we have implemented all the component of image processing unit in C++ using open sources library called OPEVCV.

Figure 3*Disease region identification*

B. Data Mining unit

Though application of this technology to the study of medical informatics is relatively new, the analytical techniques used to identify patterns have a long history. Medical data mining is used in our case to extract hidden knowledge in the medical field and to identify important patterns without fully understanding the real mechanisms behind those patterns. In order to make predictions and identify the disease in a provided image, the patterns obtained through this medical data mining are used. The data in the dataset can be classified in to two categories as visual features and external information. The visual features are the features extracted from images using image processing. These are several values which are represented in integer or floating point format. The external information is acquired by a questionnaire which is

displayed as a form on the user interface used to create the classification model for predict the skin disease.

VII. EVALUATION

Evaluation of our expert system predicted results is a significant task in the classification.Our expert system proposes five different classification algorithms (AdaBoost, BayesNet, J48, MLP, NaiveBayes) to predict the skin diseases (Melanoma, Impetigo, Eczema).Here we have given the accuracy of each and every classification model by changing the training data set using tables and graphs.

TABLE II. SYSTEM ACCURACY FOR 243 TRAINING DATA AND 60 TEST DATA

A	B	C	D
Eczema	AdaBoost	12	60%
	BayesNet	13	65%
	J48	16	80%
	MLP	17	85%
	NaiveBayes	15	75%
Impetigo	AdaBoost	13	65%
	BayesNet	16	80%
	J48	18	90%
	MLP	19	95%
	NaiveBayes	17	85%
Melanoma	AdaBoost	10	50%
	BayesNet	12	60%
	J48	17	85%
	MLP	17	85%
	NaiveBayes	16	80%

- A- Disease name
- B- Data mining classifier
- C- No of correct result
- D- Accuracy

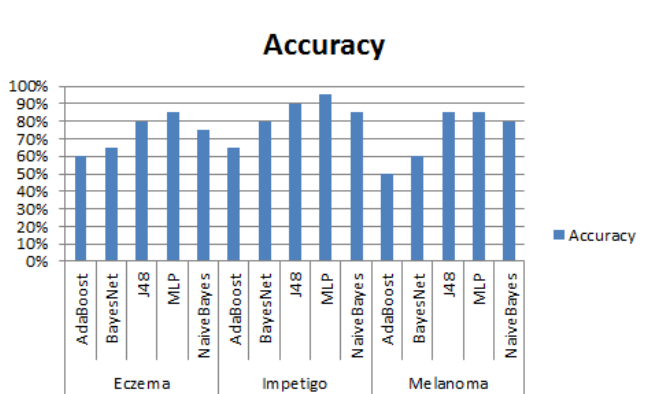*Figure 4* *Accuracy of the system shows the accuracy of the system using graph.*

Figure 4 *Accuracy of the system*

The data and graphs derived above are obtained by training the data mining classifiers made up of different algorithms (namely NaiveBayes, MLP, J48, BayesNet and AdaBoost)

using training data and then by testing the accuracy of the individual classifiers for the 3 different diseases using test data. Accuracy of the classifiers with respect to the 3 diseases is obtained as a percentage of the number of correct results to that of the total test runs. According to the accuracy of data MLP and the J48 gave us more reliable prediction. A further analysis of J48 versus MLP comparison shows that for Eczema the best classifier is J48 and not MLP for given training data sets (Figure 4). However when considering the overall correctly classified it is evidenced that the maximum overall correct results are given by MLP therefore in order to obtain the most optimum results for our system as a whole, we decided that the MLP classifier should be used.

VIII. CONCLUSION

When considering about this application's accuracy, it can over more than 85% accuracy for user. We used various classifiers to calculate and evaluate the accuracy level of our system. Multi-Layer Perceptron (MLP) and J48 are main classifiers we used. And reason to so many users would like to work with our application is, these are normally conclude our output which considering both result which are obtains from image processing method and questionnaire method. It means, our system will consist with the several questions which prepared by system from the user. And system get help answer which given for above mentioned questions to diagnosis skin disease. In this system while administrator managing the information of skin disease, symptoms, medical treatment suggestions and it prepared statement to view the summery about Skin Disease. And also this has high reliability and high performance. Both image based technique and questionnaire technique help to increase reliability and performance of the system.

IX. LIMITATIONS

In here we are arrange this application only for three skin diseases. They are Eczema, Impetigo and Melanoma. We only develop this for windows application so that is not yet develop for smart phones like Android, IOS and etc. And another thing is when capturing the image we classified the distance between camera lens and affected skin as 5cm. When capturing the image for this application makes aware to capture it without any light effects. This is only support for English language and for other ordinary languages likewise Sinhala Tamil that will not support. They are the limitation of our system and we will improve these limitations in the future.

X. FURTHER WORK

As a further development to the system we are targeting to expand the multi-platform capability through mobile support. Also the computer vision algorithms will be accelerated with GPU support. As many mobile devices are coming with high performance GPU devices we can combine above both advancements together with mobile platform support. Mobile platform is leading technologies in modern day. So we are targeting release Android mobile platform and IOS compatibility in the near future. Also with the usage and the demand of the system we will expand the number of diseases which are to be recognized by the system in to a considerable amount. Most people have very busy

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schedule so this kind of system very useful for the future. And also to attract and help local community more we are planning to enhance the local language support for the system with Sinhala and Tamil languages. That kind of improvement increase user friendliness for the system. Those kind improvements want to be done in future to our system.

XI. ACKNOWLEDGMENT

REFERENCES

[1] Munirah M. Yusof, Ruhaya A. Aziz, and Chew S. Fei - The Development of Online Children Skin Diseases Diagnosis System.

[2] Florence Tushabe, Ernest Mwebaze and Fred N. Kiwanuka - An image based diagnosis of virus and bacterial skin infections.

[3] Anal Kumar MittraandDr. Ranjan Parekh - Automated Detection of Skin Diseases Using Texture Features.

[4] https://play.google.com/store/apps/details?id=com.rubytribe.skinvision

[5] P. K. Buxton (1991) - ABC of Dermatology - Jolly & Barber Ltd, Great Britain, pp. 1-30.

[6] K. Darlington (2000) - The Essence of Expert Systems, Prentice Hall.

[7] A. Rubin (2007) - "Design of an expert system and its application to dermatopathology" - Histopathology, vol. 21, no. 3, pp. 269–274.

[8] Al. Abadi , N. K.; Dahir , N. S.; Alkareem, Z. A. (2008): Skin texture recognition using neural network, in Proceedings of the International Arab Conference on Information Technology, Tunisia, December 16-18, pp.1-4.

[9] Rubegni, P. et al. (2002): Automated Diagnosis on Pigmented Skin Lesions - International Journal on Cancer, 101, pp. 576-580.

[10] Image recognition with neural networks how to - http://neuroph.sourceforge.net/image_recognition.html

[11] RahatYasir, Md. Ashiqur Rahman and Nova Ahmed - Dermatological Disease Detection using Image Processing and Artificial Neural Network.

[12] Bareqa Salah, Mohammad Alshraideh, RashaBeidas and Ferial Hayajneh (2011) - Skin Cancer Recognition by Using a Neuro-Fuzzy System - Cancer Informatics, 2011; Volume 10: 1–11.

[13] Y. Mohanapriya and A. Manjuladevi (2014) - An efficient approach for skin cancer analysis - International Journal of Infinite Innovations in Engineering and Technology - Volume 1 Issue 1.

[14] Damanpreet Kaur and Prabhneet Sandhu - Human Skin Texture Analysis using Image Processing Techniques - International Journal of Science and Research (IJSR), India.

[15] José FernándezAlcón, CalinaCiuhu, Warner ten Kate, Adrienne Heinrich, NatalliaUzunbajakava, GertruudKrekels, Denny Siem, and Gerard de Haan (2009) - Automatic Imaging System With Decision Support for Inspection of Pigmented Skin Lesions and Melanoma Diagnosis - IEEE journal of selected topics in signal processing, vol. 3, no. 1.

[16] Damilola A. Okuboyejo, Oludayo O. Olugbara, and Solomon A. Odunaike (2013) - Automating Skin Disease Diagnosis Using Image Classification - Proceedings of the World Congress on Engineering and Computer Science 2013, Volume II, San Francisco, USA.