A Comparative Study of the Classification of Skin Burn Depth in Human

P.N.Kuan[1], S.Chua[1], E.B.Safawi[2], H.H.Wang[1] and W.Tiong[2]
[1]*Faculty of Computer Science and Information Technology Universiti Malaysia Sarawak.*
[2]*Faculty of Medicine and Health Science Universiti Malaysia Sarawak,*
94300 Kota Samarahan, Sarawak, Malaysia.
16020107@siswa.unimas.my

***Abstract*—A correct first evaluation of skin burn injury is essential as it is an important step in providing the first treatment to the patient by determining the burn depths. The objective of this paper is to conduct a comparative study of different types of classification algorithms on the classification of different burn depths by using an image mining approach. 20 classification algorithms were compared on a skin burn dataset comprising skin burn images categorized into three classes by medical experts. The dataset was evaluated using both a supplied test set and 10-fold cross validation methods. Empirical results showed that the best classification algorithms that were able to classify most of the burn depths using a supplied test set were Logistic, Simple Logistic, MultiClassClassifier, OneR, and LMT, with an average accuracy of 68.9% whereas for 10-fold cross validation evaluation, the best result was obtained through the Simple Logistic algorithm with an average accuracy of 73.2%. It can be concluded that Simple Logistic has the potential to provide the best classification for the degree of skin burn depth.**

***Index Terms*—Skin Burn; Classification; Segmentation; Image Mining Approach.**

I. INTRODUCTION

Human skin is the largest organ that covers the outer part of the body. Generally, human skin is made up of three layers as shown in Figure 1: (i) the epidermis, which is the outermost layer of the skin, (ii) the dermis, lay underneath the epidermis layer and is divided into two sub-layers, which are papillary layer (superficial) and reticular layer (deep) and (iii) the hypodermis, which is the inner layer of the skin, constitutes of fat and connective tissue [1].

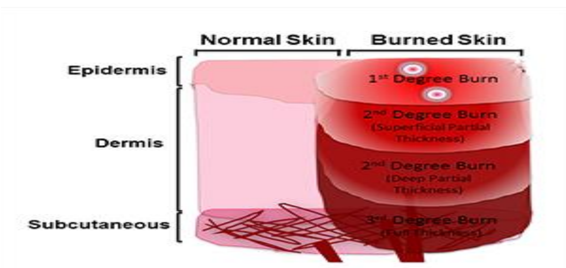

Figure 1: Human skin structure [2]

There are three degrees of skin burns: (i) First degree burn, which include only the epidermis, (ii) Second degree burn, classified into (a) superficial partial thickness burn, which involve the entire epidermis and the upper layer of the dermis (papillary layer) and (b) deep partial thickness burn, which involve the entire epidermis and most of the dermis, and (iii) Third degree burn, also known as full thickness burn, in which all the layers of the skin are destroyed, and some may extend into muscle and bone [3]. The severity of the burn injury is usually determined by the depth of the burn.

Patients with burn injuries usually consult doctors for treatment, where assessment is based on visual findings on examination. Sometimes the depth of the burn is not easily defined, as there could be mixed depth appearance. Medical practitioners with limited experience may at times be confused with the depth and severity of the burns, especially in non-clear-cut cases. In rural areas, patients may only have access to other healthcare staff at nurse-led clinics. A wrong assessment of burn depth results in inappropriate and inaccurate initial management of the burn injuries. Such mistakes translates into poor healing process, infections, undesirable scars and reduced body functions post burns.

The current state-of-the-art in burn depth classification is focused on identifying features that are capable of differentiating between healthy skin and the burn wound as well as being dependent on the feature selection performed by intelligent classifiers, such as deep learned convolutional neural network. However, the images used were manually registered with infrared markings [4].

In this work, an image mining approach is used to evaluate the image of a skin burn injury and to classify the burn injury into one of the burn depths. Based on the burn depth classification, suitable treatment can then be recommended. Many previous work in the literature used colour as the main characteristic to differentiate between different burn depths. However, this research work is focused on extracting both the colour and texture features. The feature extraction is carried out using discrete wavelet transform (DWT) and followed by applying principle component analysis (PCA) to reduce the feature dimensions [5, 6]. Gray Level Co-occurrence Matrix (GLCM) is then used to extract texture features from the decomposed images [6]. The classification was conducted using the binary classification approach, by taking one class versus all other classes. The evaluation measures used are accuracy, precision, recall, and F-measure. The main contribution of this work is the comparative study of classification of skin burn depths based on the features extracted. Another contribution includes a hybrid segmentation method, which used RGB threshold values to separate the body part from the background and Otsu's method of thresholding [7] to separate the burn wound from the body part in the image. In addition, in feature extraction, both colour and texture features were adopted and used in combination.