

Chapter 30

Chronic Wound Characterization Using Bayesian Classifier under Telemedicine Framework

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ABSTRACT

Chronic wound (CW) treatment by large is a burden for the government and society due to its high cost and time consuming treatment. It becomes more serious for the old age patient with the lack of moving flexibility. Proper wound recovery management is needed to resolve this problem. Careful and accurate documentation is required for identifying the patient's improvement and or deterioration timely for early diagnostic purposes. This paper discusses the comprehensive wound diagnostic method using three important modules, viz. Wounds Data Acquisition (WDA) module, Tele-Wound Technology Network (TWTN) module and Wound Screening and Diagnostic (WSD) module. Here the wound image characterization and diagnosis tool has been proposed under telemedicine to classify the percentage wise wound tissue based on the color variation over regular intervals for providing a prognostic treatment with better degree of accuracy. The Bayesian classifier based wound characterization (BWC) technique is proposed that able to identify wounded tissue and correctly predict the wound status with a good degree of accuracy. Results show that BWC technique provides very good accuracy, i.e. 87.40%, whereas the individual tissue wise accuracy for granulation tissue is 89.44%, slough tissue is 81.87% and for necrotic tissue is 90.91%.

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1. INTRODUCTION

The CWs have a slow healing process and due to that often are neglected after sometimes. This leads to further infection, slow down of healing and a constant trouble for the patients as well as the doctors. It becomes more serious with the old age patient with the lack of moving flexibility. When the challenge requires a long term solution the traditional process of health care is not equipped enough. World Health Organization (WHO) recommended telemedicine for healthcare delivery, diagnosis, consultation, treatment, and medical data transfer and clinicians feedback. In recent time telemedicine has started playing bigger role in healthcare systems. Advancement in technology has enabled telemedicine to intrude in various specialized field of medical study, one of which being dermatology. In 2012, Wound Healing Society (WHS) proposed standards and recommendations for optimal wound healing treatments [Whitney, J. et al. 2006]. Tele-wound monitoring (TWM) [Chakraborty, C. et al. 2015] is one of the potential applications of tele-dermatology. The major concern which leads to this work is providing treatment to CW patient in rural/semi-urban areas due to unavailability proper health care professionals. Huge time and money are wasted by villagers/urban poor people for an appointment of which 70- 75% of cases are non-emergency or non-referral cases. In such situations, telemedicine platform may provide an alternative solution. Telemedicine system doesn't have any comprehensive CW detection and analysis tool at present to provide good treatment.

There are some early works in wound image processing and characterization. Berriess et al. [Berriess, W. P. et al. 1997] proposed a color histogram clustering technique for analyzing the healing of wound tissue. Duckworth et al. [Duckworth, M. et al. 2007] discussed the wound segmentation using iterative edge detection algorithm after image is captured by smartphones. Color may provide pertinent information about wound tissue types and size reduction also a good indicator of most of the CW healing. Wound images having a non-uniform mixture of red granulation tissue, yellow slough tissue and black necrotic tissue. Perez et al. [Perez, J. et al. 2007] proposed K-means clustering approach which provides unsupervised, simple, numerical, iterative and non-deterministic tool to segment wound images based on characteristics, into k number of clusters. Zheng et al. [Zheng, H. et al. 2007] used a case-based tissue classification approach to classify square regions of interest from a grid-split structure on wound un-segmented images. From past knowledge we have observed that quantitative estimation of wound tissue classification is an urgent requirement to effectively monitor the wound healing rate. The region-based classification approach has been discussed but the tissue samples have been manually extracted as squared homogeneous regions of interest and the assessment has been partially achieved. Bayesian models have been used to determining injury severity, operative risk, surgical outcomes and intensive care unit mortality [Ho, KM. et al. 2008]. Serrano et al. [Serrano, C. et al. 2005] proposed the burn tissue classification technique using Fuzzy-ARTMAP neural network. They extracted the various color features from CIE Luv color space for classification. The supervised classifier like Support vector machine (SVM) is most frequently used for wound tissue recognition was proposed by Cao et al. [Cao, X. et al. 2009]. Serrano et al. [Serrano, C. et al. 2003] proposed a vector quantization algorithm to separate burn skin from a healthy skin in burn color images and to classify the according to the depth of the burn. Veredas et al. [Veredas, FJ. et al. 2010] proposed a binary tissue classification approach with neural networks and Bayesian classifier. Table 1 presents the existing literature survey. This technique proposed in this endeavour could be safely used in remote location where specialists' services are not readily available. The tele-medical agents could capture the image with demographic information using smartphone and send it to tele-medical hub (TMH) to classify the wound tissue type. This paper presents a methodology

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