DIABETIC FOOT ULCER ASSESSMENT THROUGH THE AID OF SMART PHONE

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ABSTRACT:

A large number of people suffer from Diabetic foot ulcer these days. Nowadays, nurses and doctors evaluate wound on the basis of visual examination of wound size and healing status, so the patients do not have an opportunity to participate in their care taking. Thus, better method that makes the patients and their caregivers enhance their role in wound care , increase the wound healing rate, reduce travelling cost and also healthcare expenses is needed. Using smart phones with a high-resolution digital camera, assessing wounds by analyzing images of chronic foot ulcers is an attractive option. Here system for wound analysis is implemented mainly Android smart phone. The image of the wound is captured by the camera of the smart phone. Later, the smart phone performs segmentation on the wound using accelerated mean-shift algorithm. The foot outline is determined on the basis of skin color, and then the boundary of the wound is detected using a simple connected region detection method. Inside the wound boundary, next is the assessment of healing status using red–yellow–black color evaluation model. Also, the status of healing is assessed, on trend analysis of time records for a given patient.

Keywords: Smart phone, mean shift Algorithm, Diabetic foot ulcer, Wound analysis, Segmentation.

[1]INTRODUCTION

Foot ulcers occurring in diabetic patients are sores on the feet that occur in 15% of diabetic patients [1]. Pressure from shoes, cuts, bruises, or any injury to the foot when not noticed, causes diabetic foot ulcers. Diabetic foot ulcers are the prime reason for non traumatic lower limb amputations. Foot ulcers are painful, susceptible to infection and very slow to heal [2] [3]. Currently, patients need to go to their wound clinic on a regular basis to have their wounds checked by their clinicians. Frequent evaluation in the clinic is inconvenient and time consuming to both patients as well as clinicians.

Also this process results in huge health care expenses since patients may require special
Transportations like ambulances. The computer-vision-based systems for diagnosis have been used in several hospitals and clinics during last few years, aiming mostly at the detection of ulcers [4]. Increasingly, mobile phones are equipped with multi-core CPUs and high-resolution image sensors. These create an opportunity to use a mobile phone to analyze a captured image for diagnosis and self-screening [5]. To better determine the wound boundary and classify wound tissues, researchers had applied image segmentation and also supervised machine learning algorithms for wound image analysis. Although this method led to good results on some of the wound images, this was not feasible to implement on current smart phones due to its computational demands. A group of researchers in France proposed a method of using a support vector machine (SVM)-based wound classification method [6],[7]. Also, the wound boundary determination was done with a particular implementation of the level set algorithm [8], in specific the distance regularized level set evolution method. The main disadvantage of the level set algorithm is its iteration of the global level set function which too computationally intensive to be implemented on smart phones. Here wound boundary determination is done by using, yet computationally efficient algorithm the mean-shift algorithm [9], for wound boundary determination. Next the status of healing for the wound is assessed on the basis red–yellow–black color evaluation model [10]. Moreover, the healing status is quantitatively evaluated, based on trending analysis of records over a time period for a given patient.


- Wound Image Analysis System overview:

  In this method wound boundary determination is done on the basis of foot outline detection results [11]. The foot detection result is considered as a binary image. The foot region is made as “white” part and the remaining region marked as “black,” thereby making it easy to locate the wound boundary within the foot region boundary. This is done finding out largest connected “black” component in the interior of the “white” region. Upon determination of wound boundary wound area is then calculated. Next the healing state of the wound is evaluated by performing color segmentation [10] [12]. The classical self-organized clustering method called K-mean [13] with high computational efficiency is used. With the completion of color segmentation, a feature vector that include area of the wound, size of the wound and dimensions for different types of wound tissues is formulated to describe the wound quantitatively. In the result database this feature vector, the original image and also image after analysis is saved. Trending analysis for wound healing is done for the time period by taking images belonging to a given patient to monitor the wound healing status.

- Mean Shift Based Segmentation Algorithm:

  In the method of mean-shift-based segmentation, the mean-shift algorithm [9] that belongs to the density estimation based non-parametric clustering methods has been implemented,
where the feature space can be considered as the empirical probability density function of the specified parameter. This algorithm analyzes the image feature space (color space, special space or the combination of these two spaces) adequately in order to cluster and can provide a reliable solution for many vision tasks [9].

- **Wound Boundary Determination and Analysis Algorithms:**

Here wound boundary determination has been implemented, because the mean-shift algorithm manages only to segment the original image into equivalent regions with similar color attributes. An object recognition method is also needed to translate the segmentation result into a meaningful wound boundary determination that could be interpreted by the users of the wound analysis system easily. As observed in [14], a recognition method known as model information to develop a conclusion, based on which a decision is made whether a region should be regarded as a candidate object, which is the wound.

[3] CONCLUSION

- In this comparative study, home care nurses collected the data from a sample of 43 adult patients with a total of 89 wounds with various etiologies [15].
- To check if the addition of a digital photograph made changes in the evaluation, the WOC nurse first completed the assessment of wound based on a verbal report from the home care nurse.
- The digital images of the wounds were then obtained by the WOC nurses. Any modifications to the management plan and original assessment of the wound were made by providing a rationale for any changes.
- The aim of this study was to compare the original and photographic assessments of diabetic foot disease using the smart phone.
- Color images of high quality of 20 patients having diabetic feet were captured using a smart phone and for 19 in them a with optimized illumination settings [16]. All photographs were then evaluated independently by four observers to check ulceration, abundant callus existed. Also comparison of the original image assessment and repeated assessments of photographic images of the feet were done.
- This comparison proved that agreement between assessments was moderate to good for all outcomes using the smart phone (56-92%) and improved upon the usage of illumination (74-100%).
- It also shows important signs of diabetic foot disease can be determined from high quality images using the smart phone. This assessment was mainly intended to monitor the patients' from their homes. Moreover the frequent assessments of the patients may potentially contribute to the early diagnosis and medication of foot disease, which in turn could prevent further complications [16].
REFERENCES


