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Injury Estimation Technique for Diabetic Patients Using Image Processing

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Abstract—*Our analysis, injury estimation technique has taken the image that is stored in the database. Now-a-day's diabetic ulcers or diabetic foot ulcers represent a significant health issue. The aim is to identify the stage of the diabetic ulcer i.e., it may be ulcer of any body part whether it is in foot or anywhere in body. Clinicians mainly base their wound assessment on visual examination of wound size and healing status, while the patients themselves sometimes have an opportunity to play an active role. Hence, a more quantitative and cost-effective technique that enables the patients and their caregivers to take a more active role in daily wound care potentially can accelerate wound healing, save travel cost and reduce healthcare expenses. With this image that is stored in database performs wound segmentation by applying the accelerated mean shift algorithm. Now, the outline of the foot is determined based on skin color, and the wound boundary is found using a simple connected region detection method. The healing status is next assessed based on red yellow black color evaluation model. Moreover the healing status is quantitatively assessed, based on trend analysis of time records for a given patient. The experimental results on wound images had sent to the doctor's mail id or registered mail id, following an IRB(INSTITUTIONAL REVIW BOARD) approved protocol show that our technique can be efficiently used to analyze the wound healing status with promising accuracy.*

1. INTRODUCTION

There are many difficulties for treating diabetic ulcers. Diabetes is a chronic disease that occur secondary to the body inability. If poorly controlled, it can result in extensive organ damage that can result in significant morbidity and mortality.

The recent advancement in technology and the rise in the availability of the internet, mobile phones, and mobile devices have shown that mobile technologies have earned their spot in healthcare research, studies and trials. The need for a new way of patient physician communication is shown by the number of DM patients that do not adhere to the recommendations of their physicians and who are not knowledgeable enough on the facts of their disease and the recommendations and advice of supporting groups of the disease.

There are many problems with current practices for treating diabetic foot ulcers. First patient go to their wound clinic have their wound checked by their clinicians. This process is not only inconvenient and time consuming for patients and clinicians, but also represent an important health care cost because patient may require special transportation, for instance ambulances. Next, a clinician's wound assessment process is based on visual examination. He/she describes the wound by its physical dimensions and color of its tissue, providing important indications of the wound type and the stage of healing . Tracking a wound's healing process across consecutive visits is a difficult task for both clinicians and patients.

Image analysis techniques is a ultimate solution to both these problems such tasks, including the measurement of area, or alternatively using a volume instrument system (MAVIS) or a medical digital photogrammetric system (MEDPHOS). This technique suffer from some drawbacks including high cost, complexity and lack of tissue classification. Determine the wound boundary and classify wound tissues, researchers have applied image segmentation and supervised machine learning algorithm for wound analysis. A French research group used a support vector machine (SVM) wound classification method. Next the idea has been employed in for the detection of melanoma at a curable stage. Although the SVM classifier method gives good results on typical wound images, it is not feasible to implement the training process and the feature extraction on current smartphones due to its computational demands. After that, the supervised learning algorithm requires a large number of training image samples and experienced clinical input, which is difficult and costly. Next image analysis algorithms that run on a smartphones. Our solution provides image analysis algorithms that run on a personal computer(PC), and thus provide a low cost and easy-to-use device for self-management of foot ulcers for patients with type 2 diabetes. Our solution engages patients as active participants in their own care. Image capture and image processing provided that the processing algorithms are both accurate and well-suited for the available hardware and computational resources. Self-management of diabetic wounds, has two tasks: (i) Develop a simple method for patients to take a image of their foot ulcers which is stored in the database; and (ii) Design a highly efficient and accurate algorithm for real-time wound analysis that is able to operate in matlab(matrix laboratory). Our solution for task (i) was specifically designed to aid patients with type 2 diabetes ulcers occurring on the sole of the feet. Due to mobility limitations, this is particularly challenging for individuals with advanced diabetes; Task (ii) was implemented by utilizing an accurate, efficient algorithm, i.e., the mean shift algorithm, for wound boundary determination, followed by color segmentation within the wound area for assessing healing status. In this paper, we present the entire process of analyzing a wound image, using algorithms that are executable on a matlab, and provide evidence of the efficiency and accuracy of these algorithms for analyzing diabetic foot ulcers. This paper is organized as follows: Section II-(i) provides an overview of the structure of the wound image analysis software system. Section II-(ii) briefly introduces the mean shift algorithm used in our system and related region merge methods. Section II-(iii) introduces the wound analysis method based on the image segmentation results including foot outline detection, wound boundary determination, color segmentation and healing status evaluation. In Section III, the mean shift segmentation algorithm is discussed. Section IV presents an image of the bottom of their foot. Experimental results are presented and analyzed in Section V. Finally, Section VI provides an overall assessment of the wound image analysis system.

2. METHODOLOGY:

Our main tool in this work is MATLAB and we have worked with MATLAB R2010a. We have designed a system where a patient can use it to assess out the level of diabetes and this information will be forwarded through email to the doctor and on the basis of the information forwarded the doctor can prescribe suitable medicines:

MATLAB: The language of technical computing

Millions of engineers and scientists worldwide use MATLAB to analyses and design the system and products transforming our world. MATLAB is in automobile active safety systems, interplanetary spacecraft, and LTE cellular networks. It is used for machine learning, signal processing, image processing, computer vision, communication, computational finance, control design, robotics, and much more.

R2010A FEATURES: MATLAB R2010a is used by 13,450 users of software informer. The most popular version of this product among our users is 7.1.The names of program executable files are matlab.exe, deactivate_ matlab.exe, activate_matlab.exe. The product will soon be reviewed by our informers.

1. For MATLAB product family:

1. Additional multithreaded math functions and, path management, and the desktop in MATLAB.
2. New system objects for stream processing in MATLAB, with over 140 supported algorithms in video and image processing block set and signal processing block set.
3. Multicore support and performance enhancements for over 50 functions and expanded support for large images in image processingtoolbox.
4. New nonlinear solvers in global optimization toolbox and optimization toolbox.
5. Ability to generate Sims cape language equations from symbolic math toolbox.

2. For Simulink product family:

1. Tunable parameter structures, triggered model blocks.
2. Code generation support for eclipse, embedded linux, and ARM processors in embedded IDE link and support package.
3. ISO 26262 certification for Real-time workshop embedded coder and polyspace products in ICE certification kit.
4. DO-178B qualification support extended to model coverage in DO qualification kit.
5. Simulink PLC coder, a new product for generating IEC 61131 structured text for PLC's and PAC's.

3. WORKING PRINCIPLE:

Our quantitative wound healing technique consists of several functional modules including wound image taken, image storage, image preprocessing, boundary determination, wound analysis by color segmentation and wound trend analysis based on a time sequence of wound images for a given patient. All these processing steps are carried out solely by the matlab software language. The functional diagram of our quantitative wound assessment system is shown as in Fig and explained below

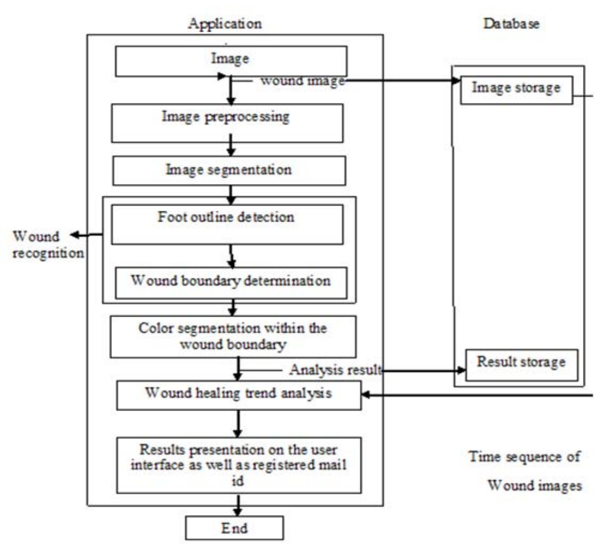


Fig 4.1.Wound image analysis technique software system

1. Image to be taken: Take an image of the wound, from the database ,which is already stored in the storage device.

2. Image pre-processing: The original image (pixel dimensions of 255X255) that divided by "2‟ both vertical & horizontal direction to pixel dimension which has proven to provide a good between the wound resolution & preprocessing efficiency.

3. Image segmentation: In case of image segmentation use K-mean algorithm in which infected area detect by „White‟& rest part marked asblack‟ these easy to locate the wound boundary within the foot region.

4. Foot outline detection: User According to foot outline detection result that can be determined by wound boundary .we carry out if the foot detection result is regarded as binary image at that time infected area detect by, White‟& rest part marked as„black‟ these easy to locate the wound boundary within the foot region .when the foot boundary not closed at that time problem become more complicated.

5. Color segmentation: According to performing color segmentation evaluate the healing state of wound. After the color segmentation feature vector describe the size & dimensions of both the wound & original best record which is the earliest record.

6. Wound healing trend: The wound feature vectors between the current wound record and the one that is just one standard time interval earlier are current trend is obtained.

7. Result analysis: Image will be store in database and system will be analyzes the infected area in percentage. In these technique, we replaced the level set algorithms with the efficient mean-shift segmentation algorithm. While it addresses the previous problems, it also creates additional challenges, such as over segmentation, which we solved using the region adjacency graph(RAG)-based region merge algorithm.

In this technique, we present the entire process of recording and analyzing a wound image, using algorithms that are executable on matlab software, and provide evidence of the efficiency and accuracy of these algorithms for analyzing diabetic ulcers. Patient‟s travel exposure is considerably reduced. The patients stress also it will reduce. The problem through images and its segmentation Doctor can easily analyze. The patient on time proper report can be given by doctor. It‟s avoided high cost, complexity, and lack of tissue classification. Foot ulcer for patients with diabetes that easy to use software for self-management. Patients are active participants in their own care. The outline of foot ulcer and accurate wound area are detecting the Image segmentation determined. The processing algorithms are both accurate and well suited for the available software and computational resources that time Patient for image taken and image processing provided. Design a highly efficient and accurate algorithm for real-time wound analysed.

4. RESULT ANALYSIS AND DISCUSSION

The result of this wound healing technique has been shown below:

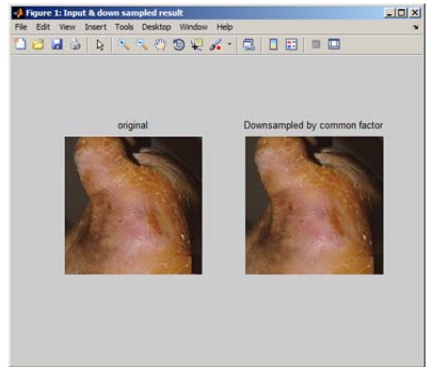


Fig. 6.1 Input and down sampled result

The figure 6.1 shows the input image with the down sampled image. The input image is down sampled. D*ownsampling* is the reduction in spatial. It is typically used to reduce the storage and/or transmission requirements of *images*. The down sampled image is then subjected to image smoothing. In image processing, a Gaussian blur (also known as Gaussian smoothing) is the result of blurring an image by a Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise.

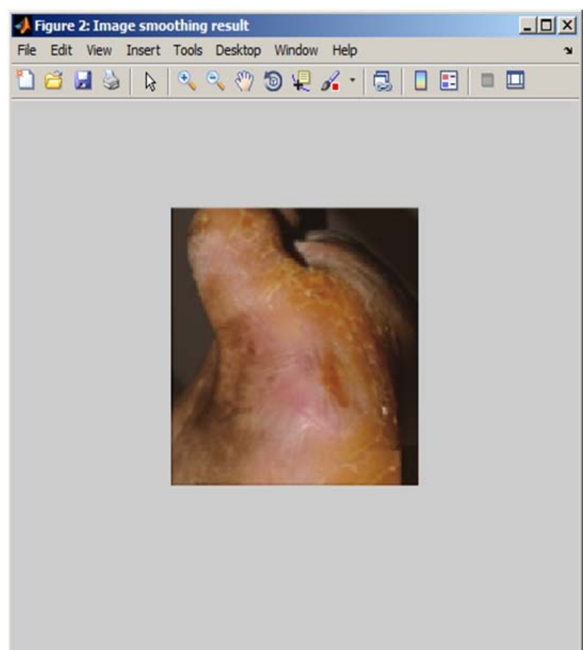


Fig. 6.2 Image smoothing result

The smoothened image is then subjected to RGB to LAB color conversion. A Lab color space is a color-opponent space with dimension L for lightness and a and b for the color-opponent dimensions, based on nonlinearly compressed coordinates. Unlike the RGB and CMYK color models, Lab color is designed to approximate human vision. Its L component closely matches human perception of lightness.Thus, it can be used to make accurate color balance corrections by modifying output curves in the a and b components, or to adjust the lightness contrast using the L component.

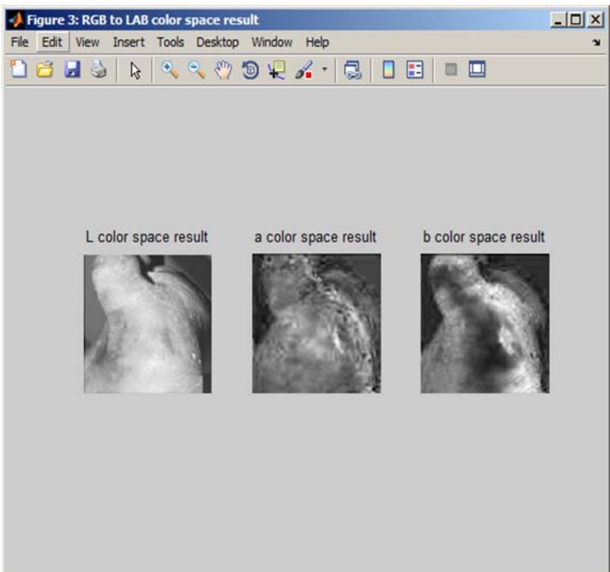


Fig.6.3 RGB to LAB color space result

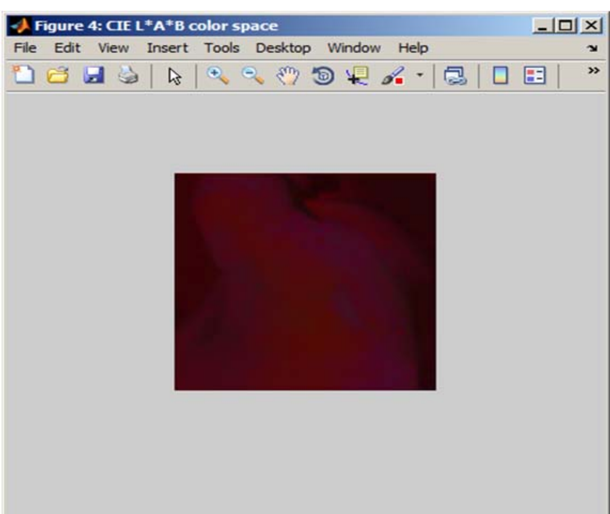


Fig.6.4 CIE L*A*B color space

After the conversion the preprocessed image is subjected to segmentation. Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The aim of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Segmentation helps to identify the largest connected segment.

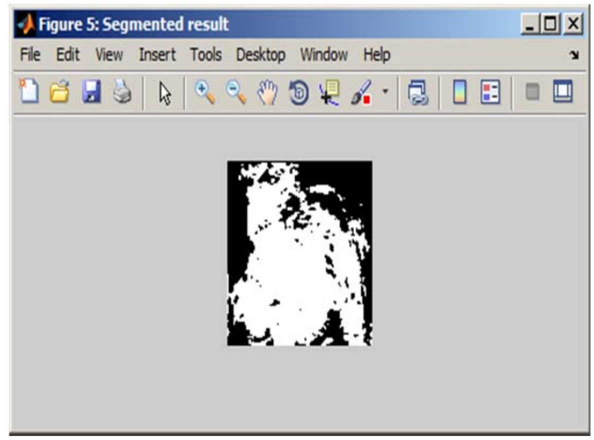


Fig.6.5 Segmented result

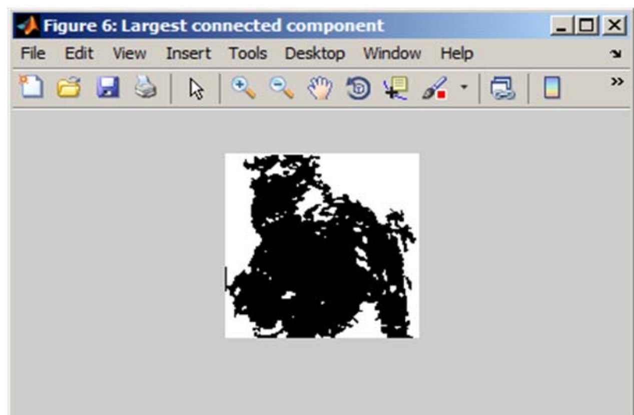


Fig.6.6 Largest connected component

Edge detection is a part of image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness.

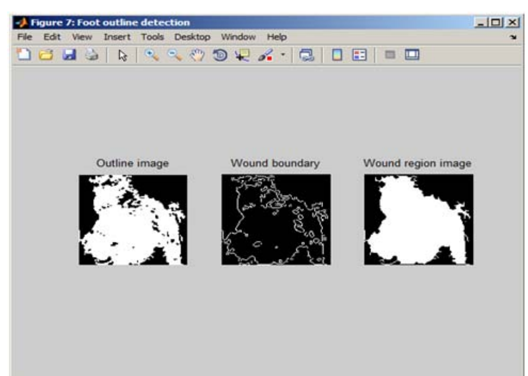


Fig.6.7 Foot outline detection

After detection of boundary the image is subjected to color segmentation. Hence color image processing has become increasingly more practical.

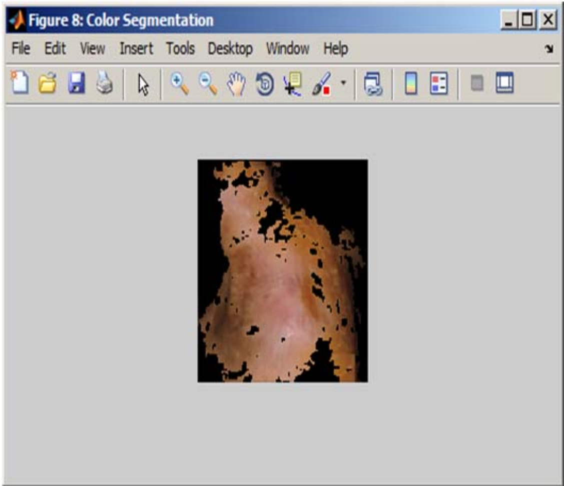


Fig.6.8 Color segmentation

The color segmented image is then subjected to K-means Clustering. K-Means is a least-squares partitioning method that divide a collection of objects into K groups. The algorithm iterates over two steps:

Compute the mean of each cluster.

1. Compute the distance of each point from each cluster by computing its distance from the corresponding cluster mean
2. Iterate over the above two steps till the sum of squared within group errors cannot be lowered any more.

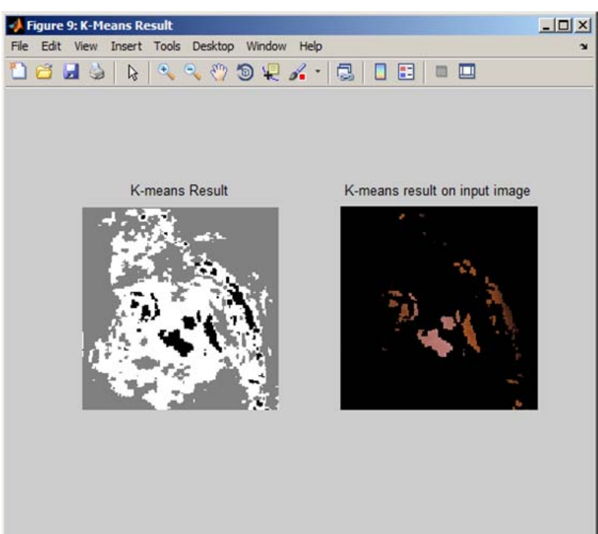


Fig.6.9 K-Mean Result

The K-Mean processed image is then subjected to Mean shift which give the cluster analysis. Mean shift is a non-parametric feature-space analysis technique for locating the maxima of a density function. Application domains include cluster analysis in computer vision and image processing.

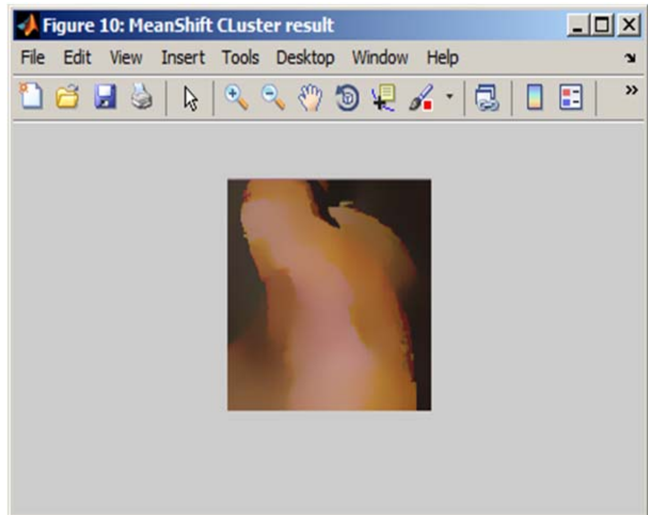


Fig.6.10 Mean-Shift Cluster Result

Wound Area in Sq mm:

9782

Initiated centroid value = 5.000000

Initiated centroid value = 10.000000

Initiated centroid value = 15.000000

Elapsed time is 0.199396 seconds.

Elapsed time is 39.422598 seconds.

Affected Skin Area in Sq mm:

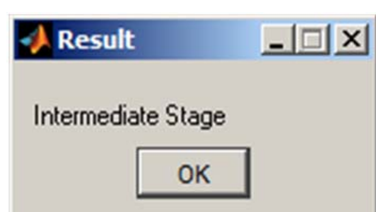
582

Total Area in Sq mm:

48387

unaffected_Percentage =

1.2028



5. CONCLUSIONS AND FUTURE SCOPE

The aim of proposed system is to provide better wound image analysis with the help of software language matlab r2010a. Here we use the mean shift based boundary determination algorithm to analysis of accurate wound boundary detection result. Results are store in database. Patient's travel exposure is considerably reduced. Doctor can easily analyze the problem through images and its segmentation. The proper report can be given to the patient on time and prescribe medicines on time. The image segmentation can be determining the outline of foot ulcer and accurate wound area is detected. The processing algorithms are both accurate and well suited for the patients. For real-time wound analysis that design a highly efficient and accurate algorithm. That is able to operate within the matlab 2010a.

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