



Smart Phone Based Wound Assessment System for Patients with Diabetes

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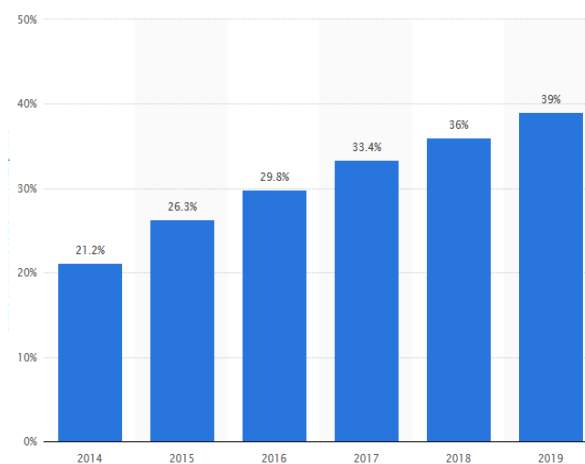
I. The current status of diabetes

Diabetes is rapidly acquiring the status of a potential epidemic in India, with more than 62 million people diagnosed with the disease. India topped the world with the highest number of people with diabetes, with 31.7 million people suffering from the diabetes.

Wounds in diabetes take time to heal. It is important to treat injuries without any delay. Even minor injuries, especially on feet, can result in serious foot ulcers, which can be fatal and even cost the patient the foot or the leg.

Keywords: Wound Analysis, Mean shift, Boundary detection, K-mean, Android based Smartphone, Images of patient with diabetes.

II. Use of smartphone



“Mobile to overtake fixed Internet access by 2014” was the big news summarizing the prediction from 2008 by Mary Meeker, an analyst at Kleiner Perkins Caufield Byers who reviews technology trends annually in may.

The mobile statistics that the team at Smart Insight curate in the regular updates to this article include:

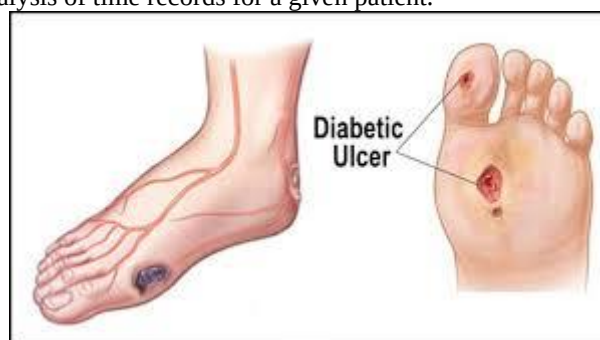
- Ownership of smartphones vs Desktops
- Mobile vs Desktops media and site use.
- Mobile advertising responses.
- Smartphones vs Tablet vs Desktop conversion rates.

The bottom line is, use of smartphones in the world has risen dramatically over the past few years. Smartphones are the perfect tools for are application as it is widely available. Smartphones are easily accessible in almost every price range, which is very convenient.

III. ABSTRACT

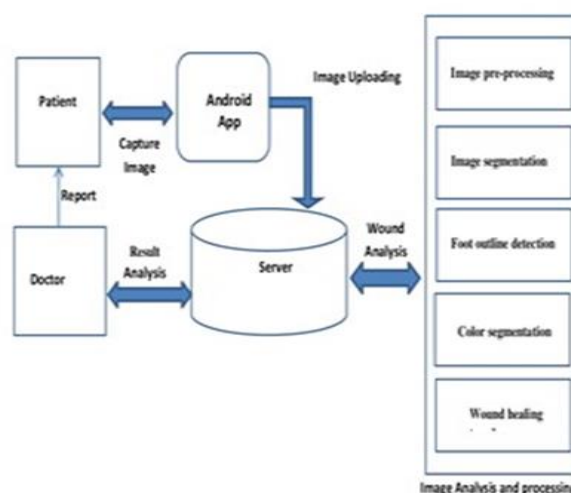
Diabetic foot ulcers represent a substantial health issue. Generally, medical professionals mainly base their wound assessment on visual examination of certain parameters like wound size, color and healing status, while patients themselves rarely have opportunity to play an active role in the process. This trivial process of visual examination can be a little pricy. Hence, a more quantitative and cost-effective examination method 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.

This is where Smart phone based wound assessment system comes into the scene. Considering the widespread use of smartphones with high resolution cameras, assessing wounds by examining the images of the wounds is an effective option. In this paper, we propose a novel wound image analysis system implemented primarily on the Android smartphone. The wound image is clicked by the camera on the smartphone with the assistance of an image capture box. After that, the smartphone performs wound segmentation by implementing the accelerated mean-shift algorithm. The outline of the foot is determined based on skin color, and the wound boundary is determined using a simple connected region detection method. Within the wound boundary, the healing status is next examined 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.



IV. Proposed system

In the system that we propose, level set algorithms are replaced with the efficient mean-shift based segmentation algorithm. The entire technique of recording and analyzing a wound image and the wound healing status using algorithms is presented and evidence of the efficiency and significant accuracy of these algorithms for analyzing diabetic foot ulcers are provided in this paper. Various steps are carried out. The steps of the entire technique is carried out sequentially. The image of the injury is captured by the high resolution camera of the smart phone. The image is sent and wound segmentation is done by implementing the accelerated Mean-Shift algorithm. The boundary of the foot is determined the color of the skin and the wound boundary is found by using an implementation connected region detection method. Within the wound boundary, the status of healing is calculated on the basis of red-yellow-black color evaluation model.



A. Wound Image Analysis System

In the image preprocessing step, we first reduce the bitmap image with high resolution to speed up the subsequent image analysis and to eradicate additional details that may complicate wound image segmentation. In this case, we reduce the original image(pixel dimensions 3264*2448) by a factor of 4 in both the horizontal as well as vertical directions to pixel dimensions of 816*612, which provides a good balance among the wound resolution and the preprocessing efficiency. Practically, we use the API for image resizing on the Android smart phone platform to make sure it is efficient.

For determining the boundary of the wounded area, firstly determine an outline of the foot within the image. So, the initial Image segmentation operation is to divide the original image into pixel groups with homogeneous color values. The foot outline detection is done by finding the largest interlinked component in the segmented picture under the condition that the color of this component is close enough to a preset standard skin color. Both the light

and dark skin colors threshold in CIE LAB space are contained into the system, which means that the algorithm is expected to work for most of the skin colors.

B. Mean shift based segmentation algorithm

This algorithm takes into consideration the spatial continuity in the image by expanding the original 3-D color range space to 5-D space, including two spatial components, since direct classification on the pixels is proved to be inefficient. The segmentation algorithm can be altered to incorporate various degrees of skin color smoothness by changing the resolution parameters. The mean-shift filtering algorithm is appropriate for parallel implementation, since the primary processing unit is the pixel. In this case, the high computational efficiency of GPUs can be exploited. The mean-shift algorithm belongs to the density. Insertion.

C. Wound boundary determination and analysis algorithm.

In this, we put into use the wound boundary verification, as the mean shift algorithm only segment the original image into similar regions with similar color features, an object identification technique is required to interpret the segmentation data into wound boundary detection that can be easily understood by the clients of the system.

As seen, a standard identification method relies on known model information to develop a theorem, based on which a decision is taken whether the region should be identified as a candidate object i.e., a wound. A verification state is also needed for further confirmation. Because this algorithm is written keeping in mind the real time implementation on the smart phones with a very few computational resources, we made the object recognition method simple while ensuring that the recognition accuracy is acceptable.

V. Algorithm

Step 1: The algorithm based on Mean-Shift describes the feature vectors domains related to each pixel as instances from an unknown probability density vector (x) and then find out clusters in this distribution as section. The center for each cluster formed is called Mode. . Given n data points are x_i where $i=1, \dots, n$ in the d-dimensional space R^d , the multivalued kernel value density estimator is shown below:

$$f_{h,K}(x) = \frac{c_{k,d}}{nh^d} \sum_{i=1}^n k\left(\left\|\frac{x-x_i}{h}\right\|^2\right)$$

Here, h is a bandwidth instance and a normalization function $h>0$ and $C_{k,d}$ is normalization constant vector. The function $k(x)$ is the profile of the kernel defined as only for $x>0$.

Step 2: For evaluating the gradient of $f(x)$, the following formula is used

$$\nabla f(x) = \frac{2c_{k,d}}{nh^{d+2}} \left[\sum_{i=1}^n g\left(\left\|\frac{x-x_i}{h}\right\|^2\right) \right] \cdot m(x)$$

$$m(x) = \frac{\sum_{i=1}^n x_i g\left(\left\|\frac{x-x_i}{h}\right\|^2\right)}{\sum_{i=1}^n g\left(\left\|\frac{x-x_i}{h}\right\|^2\right)} - x$$

Here, $g(r)=k(r)$ and n is the number of neighbors taken into account in the 5 dimension sample domain.

Step 3: In the mean-shift procedure, the current estimate of the mode y_k at iteration k is replaced by its locally weighted mean graph as shown below:

$$y_{k+1} = y_k + m(y_k) \quad (4)$$

$$K_{hs,hr}(x) = \frac{C}{h_s^2 h_r^3} k\left(\left\|\frac{x^s}{h_s}\right\|^2\right) k\left(\left\|\frac{x^r}{h_r}\right\|^2\right)$$

Here, h_s and h_r are different bandwidth values for spatial area and coverage area. . In the bandwidth, parameters are expressed as spatial and range resolutions. The vector $m(x)$ described in the above equation is known as Mean Shift instances value, since it is the differences between the current value of x and the weighted mean are the neighbors x_i around the x.

VI. Conclusion

The purpose of this system is to provide the better wound image and healing status analysis through the Smartphone. We use the mean shift based boundary detection algorithm to analysis of accurate wound boundary determination result. This method Patients are actively involved in their own care. The wound analysis systems where by physicians can remotely access the image of wound and the result of wound healing .Overall result is store in database. Patient's traveling cost is considerably reduced. Also it will reduce the patient's rare tensity and stress. Doctor can analyze the problem easily through wound images and its segmentation

The proper report of the healing can be given to the patient on time. It is easy to use for self-management and self-monitoring of foot ulcer for diabetic patients. The segmentation of image can be determining the outline of foot ulcer and accurate wound surface are detect. The processing algorithms are both accurate and well suited for real-time wound image analysis that design a highly efficient and accurate.

VII. References

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