Foot Ulcers Analysis based on Color and Texture Features for Diabetes Patients

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ABSTRACT
Diabetes foot ulcers is one of the medical issue. Presently, doctors and restorative overseers essentially build their wound assessment using visual examination of ulcer area and repairing status, but patient don't have chance to self analysis the ulcer. From now on, adoration quantitative and useful examination system that allows the patients and their parental figures to participate in consistently twisted care can animate injury recovering, save travel cost. Considering the regularity of PDAs with a high-assurance automated camera, assessing wounds by separating pictures of endless foot ulcers is a charming decision. In this framework, we lodge novel damage image processing structure completed using Color extraction and texture analysis. Here we designed the classifier depending on the color analysis and texture classification based on Normalized distance classifier.

Keywords
Diabetes, Foot ulcers, Color Extraction, Texture Analysis, Normalized Distance Classifier

1. INTRODUCTION
Current practices of foot ulcer analysis have few issues. First, patients need to visit the doctor every time for the checkup. This requirement for successive clinical assessment is not just badly designed and tedious for patients and clinicians, additionally speaks to significantly social insurance cost since patients may require exceptional transportation, e.g., ambulances. Second, a clinician's wound evaluation process depends on visual examination. He/she depicts the injury by its physical measurements and the shade of its tissues, giving vital signs of the injury sort and the phase of mending. Since the visual appraisal does not deliver target opinion and quantiable values of the recuperating status, following a wounds mending process crosswise over sequential visits is a troublesome assignment for both doctors and patients. The injury picture is caught with the camera on the Smartphone with the help of a picture. From that point forward, the Cell phone performs twisted division by applying the quickened mean-move calculation. In particular, the diagram of the foot is resolved in view of skin shading, and the injury limit is discovered utilizing as usage associated locale location technique. Inside the injury limit, the mending status is next evaluated in view of red–yellow–black shading assessment show. Diabetic injury administration requires long haul, rehashed estimations to guarantee restorative viability. As the quantity of patients requiring wound administration expands, the accessible doctor patient time for straightforward injury following winds up plainly lacking. All things considered, there is a need to give a way to precisely track diabetic injuries outside of a clinical setting.

2. OBJECTIVES
The objective of the proposed system is given below:

(a) A more quantitative and cost-productive examination technique that empowers the patients and their caregivers to play a more dynamic part in day by day wound care conceivably can accelerate wound healing, save travel cost and reduce healthcare expenses.

(b) Our arrangement helps patient to take picture of ulcer using the Smartphone and then processing it using the image processing algorithm to extract color features and texture feature.

3. LITERATURE SURVEY
In literature, the problem and the previous techniques of ulcer detection system is described.

Lei Wang et.al states that a structure that Design a very productive and exact calculation for continuous injury investigation that can work inside the critical computational limitations of the cell phone. The model result demonstrates that the calculation shows signs of improvement likelihood with the assistance of wound picture and recuperating status investigation. This paper proposed a framework that makes a difference clients consequently twisted limit has been totally decided and the injury range ascertained. [1]

Hazem Wannous et.al This paper speak to The quantitative evaluation of wounds on visual examination and manual system to depict the state of the injury picture parameter like surface, profundity and the organic nature of the skin tissues Wound surface and shape are right now measured with a conventional technique.[2]

Sadhana et.al this paper expresses that the general structure of framework and control stream of calculation. This paper incorporate the primary parts of the arrangement that is Image handling, Image Segmentation, Foot layout location, Shading division, Wound mending. [3]

A.Suresh.et.al, proposed, the Chan-Vese dynamic form based technique for medicinal reason to effectively recognizing of ulcer influenced range in a foot of a diabetic patient. Chan-Vese dynamic form technique was utilized for division. It considered as of perception of the diabetic ulcers in the foot and utilized division and spoken to with compelling ulcer region with shading and furthermore in dim shading pictures. [4]

Simerjit Singh.et.al, proposed, Diabetic foot ulcer is described by an established set of three of neuropathy, ischemia, and disease. Each of these has a multifactorial aetiopathogenesis. These variables are intensified by mechanical anxiety made by foot distortions. The most regularly utilized arrangement frameworks are the Wagner-Ulcer Order framework and the University of Texas Wound Classification. These characterizations help to foresee the result of this condition.

Anticipation of this condition is vital to forestall long haul grimness and here and there mortality. [5]

4. PROPOSED SYSTEM

Description:-Above figure shows the flow diagram of proposed system. Once the Image is captured it is smoothen using Median filter to remove the noise from the image. The next block is to down-sample the image for the compatibility purpose. Then the image is segmented using color segmentation algorithm. The color features are obtained to detect the severity of the ulcers using its color type. The color values are obtained from the image part by concerting RGB image to its respective RYB values. The next block is feature extraction to extract the different types of features for example, color movement and texture feature. Gabor filter is used for the texture feature. Gabor filter is a linear filter used for edge detection. Gabor filters are directly related to Gabor wavelets. The final block is classifier to classify the image. Normalized minimum distance classifier is used in this system. The dataset of some images obtained from web are trained using this algorithm and the values for the mean and standard deviation for each pixel is been stored. Then the input image is being processed and its obtained feature values are matched to the trained images file and the result is displayed accordingly for different level of foot ulcers.

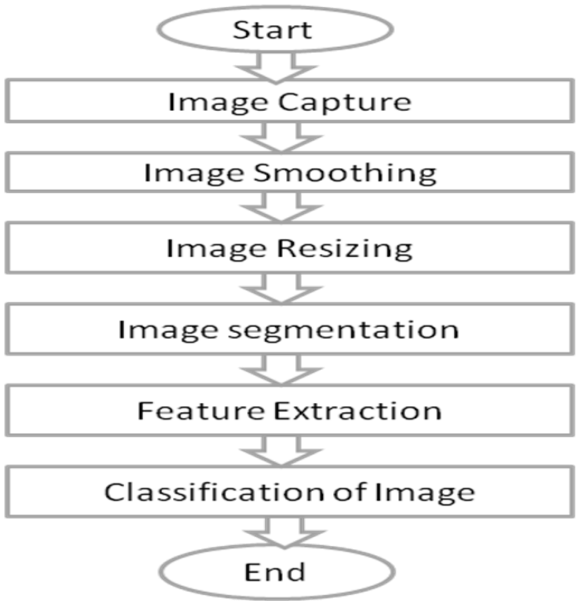

Fig 1: Flow diagram of proposed system

5. RESULTS AND DISCUSSION

The objective of the proposed system is obtained using the color segmentation for the analysis of the ulcers based on the color of the image and the texture feature calculation using the Gabor filter. The RYB (red–yellow–black) wound classification model, proposed in 1988 by Arnqvist, Hellgren and Vincent, is a consistent, simple assessment model to evaluate wounds [07]. It classifies wound tissues within a wound as red, yellow, black or mixed tissues, which represent the different phases of the wound healing process. Specifically, red tissues are viewed as the inflammatory (reaction) phase, proliferation (regeneration), or maturation (remodelling) phase; yellow tissues imply infection or tissue containing slough that are not ready to heal; and black tissues indicate necrotic tissue state, which is not ready to heal either [07], [08].

The output of the proposed system analyzed on different images of the diabetes foot ulcers which were tested from the diabetes doctor with his visual analysis result the experimental results were matched. Some Sample images and their analysis is shown below:

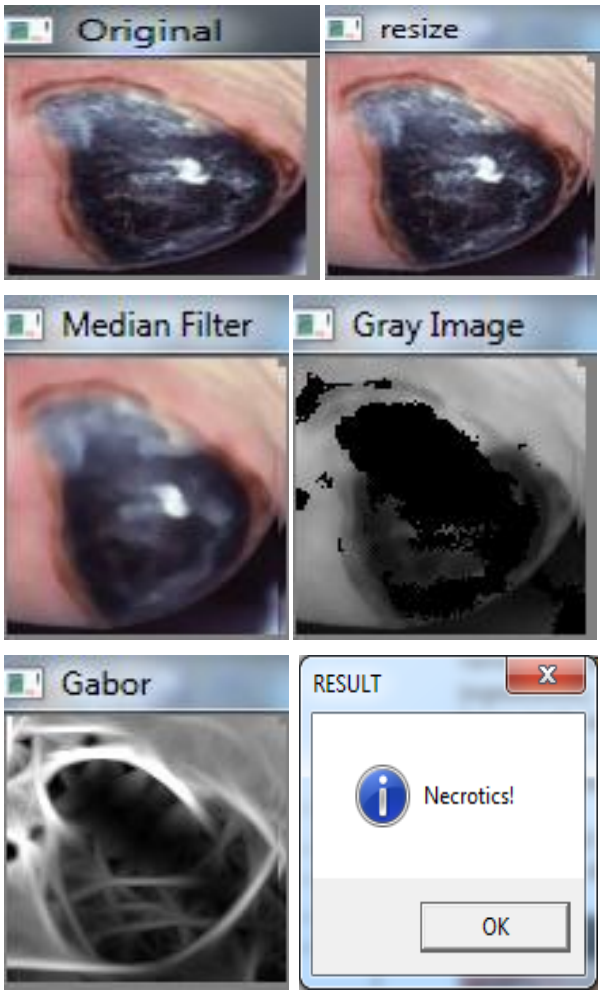

Fig 2: Experimental Results of Necrotic Type Imag

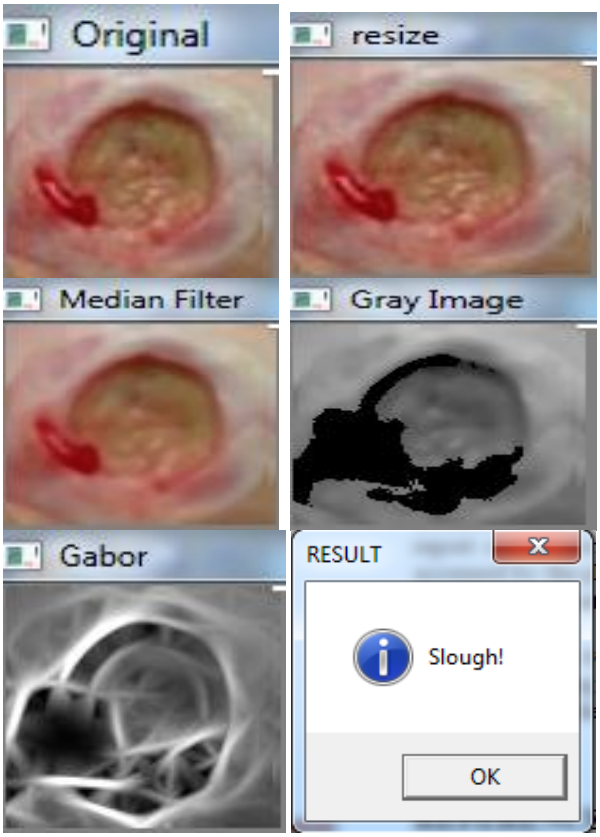

Fig 3: Experimental Results of Slough Type Image

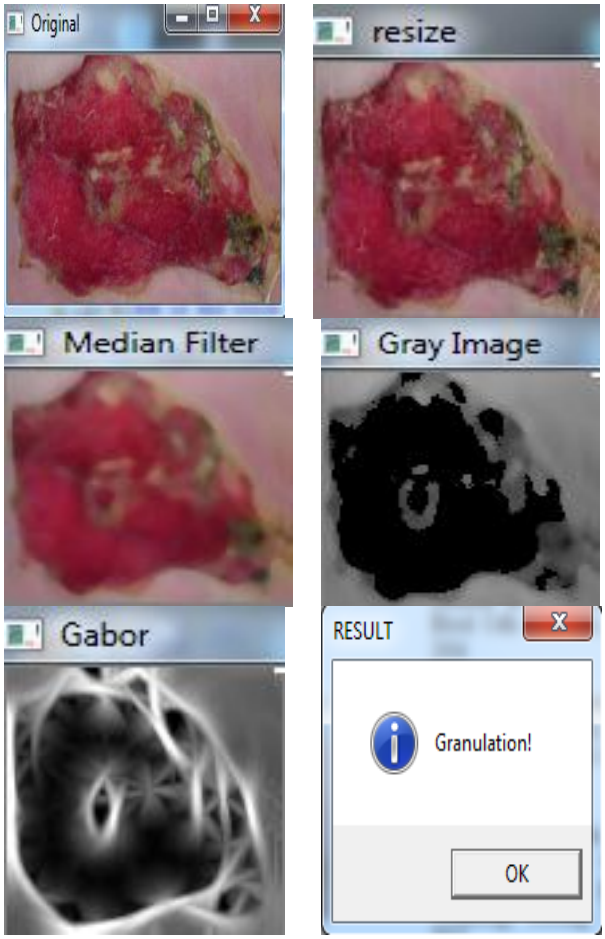

Fig 4: Experimental Results of Granulation Type Image

The Table 1 shows the color feature values obtained using the algorithm and the analysis result based on that values which matches the visual analysis of the doctor.

Table 1: Color Analysis of the above Image Samples

Image Database	**Feature Values in BGR Format**			**Experimental Result**
	RED Color	Yellow Color	Black Color	
Fig 2	0.5995 0.6288 0.5235	0.625 0.0541 0.2389	0.5995 0.6288 0.5415	Necrotic
Fig 3	0.7015 0.6497 0.9992	0.7277 0.0394 0.0458	0.7015 0.6497 0.0444	Slough
Fig 4	0.8455 0.8381 0.9658	0.8722 0.0 0.0	0.8455 0.8381 0.2988	Granulation

For the texture analysis the gabor feature where calculated which are shown in the below table.

Table 2: Texture Analysis of the above Image Samples

Image Database	**Texture Features**		**Experimental Result**
	Mean	Standard Deviation	
Fig 2	65.36677	68.0012	Necrotic
Fig 3	57.103	51.698	Slough
Fig 4	57.303	65.10023	Granulation

For the above result the values varies when we do the phase analysis of the same image. The mean and standard deviation decreases as the image start to heals.

6. CONCLUSION

The objective of proposed framework is to give the better wound image and healing status investigation through the Smartphone. The color and texture features are obtained and the analysis can be done by capturing the foot ulcers images at certain time and matching the analysis result with the previous one. The stage of the foot ulcers is decided using the changing feature values. The analysis report can be stored in the database which can be easily accessed by the physicians. This saves the travel cost and the efforts to visit the hospital every time which releases the foot patient.

In future this system can be implemented using the machine learning algorithms and the server can be maintained for the application. For the diabetes patient Image Capture Box can be designed for their feasibility to capture the image. The GUI will be designed to give the suggestion of medication to Patient as per the analysis result of the system which patient can consult with doctor.

7. REFERENCES

[1] Lei Wang, C.Pedersen, Diane M.Strng, Bengisu Tulu. "Smartphone based Wound Assessment System for Patient with Diabetes." IEEE (2015): 01-11.

[2] Hazem Wannous, Yves Luccas, Sylvie Treuillt. "Enhance assessment of wound healing process by accurate multiview tissue Classification." IEEE (2013): 01-14.

[3] Sadhana S.Jadhav, Manisha M.Naoghare. "A survey on wound assessment system patient of foot ulcer diabetes identification based on Smartphone." IJIRCCE (2015): 01-05.

[4] V. Falanga, "The chronic wound: Impaired healing and solutions in the context of wound bed preparation," Blood Cells Mol. Dis., vol. 32, no. 1, pp. 88–94, Jan. 2004

[5] N. Singh, D. Armstrong, and B. Lipsky, "Preventing foot ulcers in patients with diabetes," JAMA: the journal of the American Medical Association, vol. 293, no. 2, pp. 217–228, 2005

[6] L. Wang, P.C. Pederson, D. Strong, B. Tulu and E. Agu," Smart phone based wound assessment system for diabetic patients", presented at 13th Diabetes Technology Meeting, San Francisco, CA,USA, Oct. 2013

[7] J. Arnqvist, J. Hellgren, and J. Vincent, "Semi-automatic classification of secondary healing ulcers in multispectral images," in Proc. IEEE 9th Conf. Pattern Recog., Nov. 1988,pp.459–461.

[8] J. R. Mekkes and W.Westerhof, "Image processing in the study of wound healing," J. Clin. Dermatol., vol. 13, no. 4, pp.401,407,Jul.1995.