Review of Classification Techniques of Foot Ulcer Detection

Riddhi Desai  
Department of computer Engineering  
Sarvajanik collage of Engineering And Technology  
Surat, Gujarat

Prof.Bhumika Bhatt  
Department of computer Engineering  
Sarvajanik collage of Engineering And Technology  
Surat, Gujarat

ABSTRACT
Foot ulcer is major threats to public health. Especially in the people who suffers from dainties from a long time period. Diabetic is leading dieases that need to attention. One of the survey says that approximately 15% of people with will be affected by foot ulcer during their life time. Diabetic foot ulcer (DFUs) often co-exist with vascular insufficiency. The foot ulcer rare the major cause of gangrene and the death related to gangrene. Also a foot ulcer is taken a long time to heal. Therefore monitoring the foot ulcer is necessary in early stage, and to study necessary algorithm makes it easier to detect foot ulcer and heal the patient in early stage. This paper review different classification techniques to detecting foot ulcer at early stage.

Keywords
Foot ulcer, Texture Segmentation, Classification

INTRODUCTION
In diabetic foot, sensation loss predisposes to skin ulceration, which may result in amputation. Therefore, understanding and detection of factors responsible for plantar ulceration and their measurement reproducibly is necessary to save the foot at risk. Diabetes is the leading cause of the no traumatic lower extreme amputation in the united state [2]. For individuals with type 2 diabetes, foot ulcers constitute a significant health issue. Around 5–6 million individuals affecting from it in the US [2] Foot ulcers are painful, susceptible to infection and very slow to heal.

The National Centers for disease control reports that over 16 million people in the United States have diabetes. For these approximately 25% will develop some sort of foot disease. 20% of the hospitalization cases for diabetics are due to this foot disease each year [6]. Over foot has five main functions: I) It is the base support for the body. II) It can adapt to uneven ground. III) It acts as a shock absorber for the body. IV) It provides leverage for propulsion, and V) It absorbs transverse leg rotation. Loss of any one of these functions can be detrimental to the patient, and is often noticed in diabetic person [1]. The foot ulcer generally agreed that non-mechanical factors such as general neuropathy, dry skin, and/or vascular problems are often major causes for skin ulceration, with neuropathy of prime importance [1].

Unfortunately India has the highest number of people suffering from diabetes with World Health Organization reports showing about 32 million people suffering from diabetes in 2000. According to the International Diabetes Federation, the number of people suffering from diabetes in India is around 40.9 million as per the Diabetes Atlas2006 [1] and is going to rise to 69.9 million by 2025. Therefore monitoring cutaneous tissue of foot and early prevention by identifying and relieving the foot ulcer in shoe insole is a necessity.

This review paper is organized as follows. Firstly, the review on other approaches for foot ulcer detection, after that dffracr image processing methods review to detecting foot ulcer. Finally the ending towards the conclusion.

I. DETECTION APPROCH
1.1 Messuring foot pressure
Measuring Foot Pressures in Diabetic Patients by Jennifer N. Novak, Bauer E. Sumpio, Peter A. Blume, James D. Beaty, John D. Enderle stated that many techniques are available to analyze the plantar pressure of the foot both quantitatively and qualitatively. They proposed two techniques that will be used to analyze the plantar pressures are the Hams Mat and Tekscan. The purpose of this project is to optimize the system of measuring the plantar pressures of the feet of a diabetic patient. A correlation between the two techniques will be determined in order to save time for the physician and patient. These two systems have a lack of repeatability and consistency that make it difficult for the physician to determine precise pressure areas of the foot where the pressure is dangerously high [1].

1.2 Electronic orthotics shoe
Electronic Orthotics Shoe for Preventing Ulceration in Diabetic Patients by Foad Dabiri, Alireza Vahdatpour, Hyduke Noshadi, Hagop Hagopian and Majid Sarrafzadeh Stated that they have developed a wireless electronic orthotics composed of lightweight embedded systems and non-invasive sensors, Which
can be used by diabetic patients suffering from peripheral neuropathy. This system monitors feet motion and pressure distribution beneath the feet in real-time and classifies the state of the patient. Also detects the conditions that could potentially cause a foot ulcer. This system enables a continuous feedback mechanism for instance in case of an undesired behavior or condition a preemptive message wirelessly to the patient and the patient’s caregiver. One of the main challenges in the proposed system is interpretation of data and pattern classification procedures. Data from pressure sensors and accelerometer are used to classify how the person wearing the shoe is moving and to analyze his/her activities. Furthermore, there are two major problems that are reliability of the system/service and its security [1].

1.3 Image processing

Image processing and their application for biomedical state that visual features such as shape, color and texture are extracted and characterize image. Also these techniques give the data in statistical form. So it is more reliable to cure the foot ulcer in early stage. In this paper we are going to give brief introduction about image processing techniques.

II. Image processing Stage

There are many steps for diagnosis of foot ulcer such as pre-processing, image segmentation, feature extraction, classification for diagnosis. In this paper we discuss each steps and its methods to detecting foot ulcer.

2.1 Image preprocessing:

Preprocessing is the first stage of detection to improve the quality of images, removing the irrelevant noises such as salt and paper, Speckle, Poisson noise etc. These noises cause inaccuracies in segmentation [8]. We can apply various filter such as median filter, adaptive median filter, mean filter, gaussian filter and adaptive wiener filter for de-noising.

2.2 Image Segmentation:

Image Segmentation separates ROI image from background. ROI is a region that we want to examine. Texture segmentation is the separating an image into different regions to recognize the boundary between different textures in the image. Output of these steps is affected ulcer region. I am going to use variegated coloring algorithm for segmentation. Some of them are described below.

1) Region Growing
2) Differential Evolution
3) Edge Detection
4) Gabor Filter

1. Region Growing: Region growing refers to a class of image segmentation methods where the goal is to find regions that separate the region, which have same value as we specified. The method is based primarily on spatial considerations. Some of the techniques used are local, in which small areas of the image are processed; others are global, where the entire image is considered during processing. Methods that can combine local and global techniques, such as split and merge, are referred to as state space techniques and use graph structures to represent the regions and their edges (boundaries)[10].

2. Differential Evolution: Differential evolution (DE) is a population-based search strategy very similar to standard evolutionary algorithms. The main difference is in the reproduction step where offspring is created from three parents using an. arithmetic crossover operator. DE is defined for floating-point representations of individuals. Differential evolution does not make use of a mutation operator that depends some probability distribution function, but introduces a new arithmetic operator, which depends on the differences between selected parents. Randomly selected pairs of individuals [11].

3. Edge Detection: finding the boundaries between objects, thus defining the objects themselves, indirectly, performs Edge detection, as a method of image segmentation. First marking points that may be a part of an edge usually implement this method.
These points are merged into line segments, and the line segments are then merged into object boundaries. The most common method of finding edges in a digitized image is to apply a spatial differentiation operator to small blocks of pixels, local neighborhoods, within the digitized image [10].

4. Gabor Filter: Gabor filters are localized filters Due to this they are useful in extracting sub-band features in images. Gabor filters have the ability to perform multi-resolution decomposition due to its localization both in spatial and spatial frequency domain. However, normally the effective width of a filter in the spatial domain and its bandwidth in the spatial-frequency domain are inversely related according the uncertainty principle. That is why Gabor filters are well suited for this kind of problem [3].

![Figure 2. Image segmentation [14]](image)

After completion of the segmentation method some texture and color feature ware extracted and the classification is done on segmented image.

2.3 Classification Methods:

The system classifies the image into tissue like Granulation Tissue, Slough, Necrotic tissue.

1) Granulation Tissue: The granulation tissue comprises new connective tissue and tiny blood vessels that form on the surfaces of a wound during the healing process. It looks light red and/or dark pink in color.

2) Slough: slough is a yellow fibrins tissue that consists of fibrin, pus, and proteins’ material. It can be found on the surface of a previously clean wound bed and it is thought to be associated with bacterial activity. The accumulation of necrotic tissue or slough in a chronic wound is of major clinical significance.

3) Necrotic Tissue: Necrotic tissue is basically dead tissue that generally results from an in adequate local blood supply. It is of black color and found in a wide variety of wound types, including burns and all types of chronic wounds [14].

There are many methods use to classify this tissue. Some of them are reviewed below.

1) K-Mean: K-Nearest Neighbor other name is “LAZY Learning Algorithm”. The algorithm has the simplest logic. All the data set elements are the instances in some specific dimension space, taking the unknown sample value and getting its points in the set of space. Calculate the distance of sample value with each point in space, with any distance formula such as Euclidean distance, Munkowski, Mahalanobis city block, and chessboard. Now the next step is to sort the distances in ascending order, finding the k number of nearest points. The k should be odd for decision-making. The maximum nearest neighbors will decide the class of unknown given sample [6].

2) ANN: Neural Network based segmentation is totally different from conventional segmentation algorithms. In this, an image is firstly mapped into a Neural Network. Where every Neuron stands for a pixel [18], thus image segmentation problem is converted into energy minimization problem. The neural network was trained with training sample set in order to determine the connection and weights between nodes. Neural network segmentation includes two important steps feature extraction and image segmentation based on neural network. Feature extraction is very crucial as it determines input data of neural network [18], firstly some features are extracted from the images, such that they become suitable for segmentation and then they were the input of the neural network. All of the selected features compose of highly non-linear feature space of cluster boundary. ANN’s are networks of interconnected nodes having various stages based on adaptive biological learning.

3) SVM: The support vector machine (SVM) that uses SVM algorithm is based on learning, testing, and performance evaluation. Learning involves optimization of a convex cost function. Testing is based on model evaluation using the support vectors to classify a test dataset. Performance evaluation is based on error rate determination as the test dataset size tends to infinity [6][12].

4) Bayesian Network: The algorithm workings depend upon the probability of the instance and all the features are independent. Using the Bayesian theorem, To check the training data, compute the previous probabilities $P(C)$ of each class, multiply this with likely hood i.e. $P(X|C)$, then dividing it with the evidence sum $P(X)$ of all classes. The maximum valued class later is assigned to the unknown sample data. The algorithm is fast and accurate as compare to KNN. It is not sensitive towards the garbage and irrelevant features. This is applicable for real as well as discrete data. The issues with Bayesian algorithm
are the liberty assumption of classes, the zero probability problems and the laplacian estimator [6].

III. Conclusion
The objective of this paper is to discuss all the phase of detecting the foot ulcer and its classification methods. Through theoretical studies here we concluded that SVM is more accurate algorithm than K-Mean.

REFERENCE