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INSPECTION AND DETECTION OF DIABETIC FOOT USING IMAGE PROCESSING AND DEEP LEARNING

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Abstract : Diabetes (*aka* ***Diabetes mellitus***) is one of the major metabolic disorders which is caused due to inability of pancreas to produce enough insulin in order to control the blood sugar levels in the human body. Diabetes untreated and uncontrolled can further develop *"Diabetic Peripheral Neuropathy"*, a family of nerve disorders caused by diabetes. Diabetes detection at an early stage through regular monitoring and screening is the effective way to control blood glucose levels. This journal emphasizes on detection of diabetic foot using Deep Learning and Image Processing, and describes sophisticated approach on processing thermal images of diabetic foot using techniques, such astraining data using deep learning, Image Filtering and Enhancement, Image Segmentation and Feature extraction. These techniques assist doctors in detecting and monitoring patient's condition with less reviews.

Keywords :*Deep Learning, Image Filtering, Image Segmentation, Feature Extraction*

I. INTRODUCTION

When it comes to image classification from visual content, it is considered to be a challenging task. The techniques in this task involves image filtering and enhancement, image segmentation, feature extraction,region of interest based processing. Image enhancement techniques involves deblurring the image, morphological filtering, contrast adjustment, filtering. After image enhancement a modified version of original image is available for further processing which highlight attributes and certain features. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.Image Segmentation technique is used to partition an image into meaningful parts having similar features and properties. Feature Extraction extracts certain differentiable characteristics like size, shape, color, specific patterns, brightness, edge density, particular attributes provided to a learner or model which works on functional principles of deep learning techniques. Comparison of these characteristics for input data is done by learner or model. A simple piece of information with less complexities can be solved using simple decision making statements, but scenario where data becomes larger, it is very difficult to manipulate and maintain that data, here machine learning is an useful tool.
Deep Learning is one the branch of Machine Learning methods, involves learning differentiable data

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characteristics, attributes, various patterns and useful pieces of information for categorizing and differentiating a particular entity from other entities. Deep Learning architectures neural network, applicable to numerous fields such as, Object Detection, Super Resolution Imaging, Semantic Segmentation, Speech Recognition, Audio Recognition, Sequence Classification, Text data Classification. Deep Learning algorithms can be applied to unsupervised learning tasks like, In an Image recognition application object detectors can be trained to classify every pixel of an image.

II. IMAGE SEGMENTATION TECHNIQUES

Threshold Method:
The simplest methods in Image Segmentation technique is Thresholding. Images pixels are divided into their respective intensity levels. This method is based on a threshold value), where binary image is obtained from gray-scale image. Usually these method is used where actual features of the image objects are lighter than background noise.
Edge Detection Method:
Edge detection techniques are well known techniques in Image Segmentation. This method include sharp changes in intensity at the edge region of the targeted object in an image. There are two types of edge segmentation methods, Gradient based methodsandGray histograms.These methods basically outputs digital binary image. Edge detection techniques locate the edges where either the second derivative has zero crossingsor the first derivative of intensity is greater than a particular threshold or. In edge based segmentation methods, first of all the edges are detected and then are connected together to form the object boundaries to segment the required regions.
Clustering Method:
Clustering is the method where the data elements are divided into clusters so that elements in same cluster are more similar to each other than others. In this section Semi Supervised Clustering is discussed, which plays a noteworthy role in image processing which helps the image segmentation to produce the efficient result of an input image. Semi Supervised clustering which is combination of both labeled and unlabeled data points, typically with the large amount of unlabeled data and a small amount of labeled data. Semi Supervised clustering falls between unsupervised and supervised. It means that a small amount of human assistance or prior information is given during the clustering process. There are two types of clustering methods: Hard Clustering and Soft Clustering.
Compression Based Method:
In this method each segment is described by its texture and boundary shape. Compression based methods postulate that the optimal segmentation is the one that minimizes, over all possible segmentations, the coding length of the data.The connection between these two concepts is that segmentation tries to find patterns in an image and any regularity in the image can be used to compress it.
Watershed Transformation:
In watershed transformation concept called a topographic interpretation is used. The watershed methods consider the gradient of image as topographic surface. The Boundaries are represented by the pixels having more concentration gradient. The intensity is represented by minima where the basins have hole. The adjacent basins are merged together wherever water reaches the border of basin. A Segment is represented by the pixels draining to a common minimum forming a catch basin. In orderto maintain separation between basins, dams are required which are the borders of region of segmentation.

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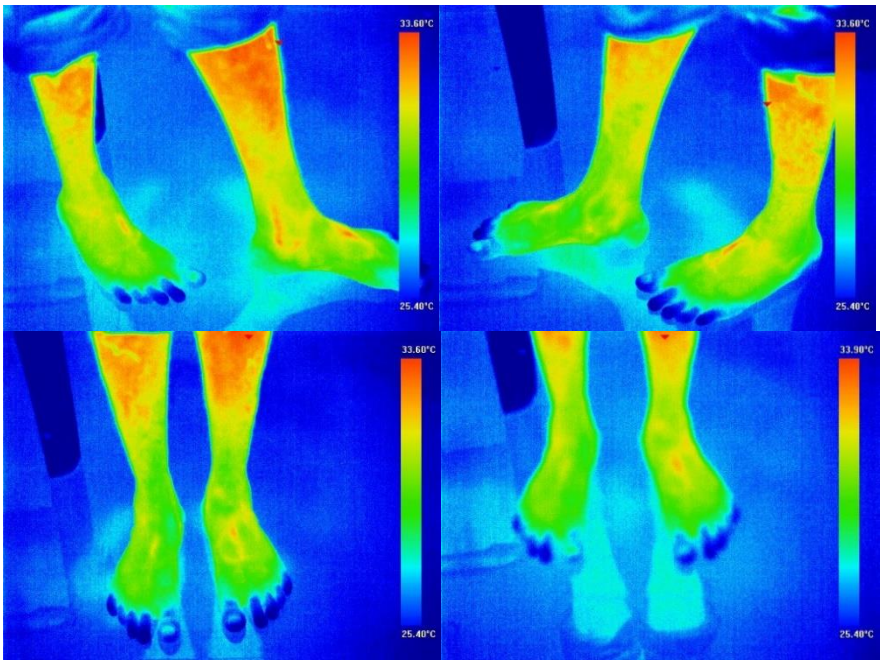
III. FEATURE EXTRACTION

Color features:
Color is one of the most important features in image processing. Color features are defined subject to a particular color space or color model. A number of color spaces have been used in literature such as RGB, HSV, LUV and HMMD. Once the color space is specified, color feature can be extracted from images or specified regions. A number of important color features have been proposed in the literatures, including color histogram, color moments (CM), color coherence vector (CCV) and color correlogram, etc. Among them, CM is one of the simplest yet very effective features. The common moments are mean, standard deviation and skewness.
Texture features:
Texture is useful characterization for a wide range of image. It is generally believed that human visual systems use texture for recognition and interpretation. In general, color is usually a pixel property while texture can only be measured from a group of pixels. A large number of techniques have been proposed to extract texture features. Based on the domain from which the texture feature is extracted, they can be broadly classified into spatial texture feature extraction methods and spectral texture feature extraction methods. For the former approach, texture features are extracted by computing the pixel statistics or finding the local pixel structures in original image domain, whereas the latter transforms an image into frequency domain and then calculates feature from the transformed image. Both spatial and spectral features have advantage and disadvantages.
Shape features :
Shape is known as an important cue for human beings to identify and recognize the real-world objects, whose purpose is to encode simple geometrical forms such as straight lines in different directions. Shape feature extraction techniques can be broadly classified into two groups, viz., contour based and region based methods. The former calculates shape features only from the boundary of the shape, while the latter method extracts features from the entire region.

IV. RESULTS



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VI. CONCLUSION

In this paper, a comparative study is done in order to detect a diabetic foot and discriminate it from non-diabetic foot. The process to identify the diabetic foot involves techniques like image filtering and enhancement, image segmentation, feature extraction and identification using deep learning mechanism.

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