DIABETES LEVEL FINDING USING HUMAN PALM THERMAL IMAGES

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Abstract:

Diabetes mellitus, commonly called as Diabetes, in which the person has high sugar level. Insulin, produced by the pancreas, is responsible for controlling the level of blood glucose level. The lack of production in insulin leads to Diabetes. If the problem left untreated, it leads to serious complications includes cardiac problems. There are various invasive techniques to diagnose diabetes. In this project we are using mid infrared rays instead of near infrared rays to acquire the thermal image of the palm. The thermal images are pre-processed and segmented using k means clustering. Then they are subjected to feature extraction.many data analysis software packages provide for feature extraction. Common numerical programming environments such as NumPy,MATLAB,etc provide some of the simple feature extraction techniques via built-in commands in this project,we are using principal component analysis using NumPy for feature extraction. After extracting the features,the gray scale image is classified using classifiers. The classifiers like Support Vector Machine (SVM), Probabilistic Neural Network (PNN), K-Nearest Neighbour Network (KNN) are used to diagnose the thermal images of palm. In this project we are using support vector machine (SVM) as the classifier. Because support vector machine (SVM) is suitable for supervised learning than other available classifiers.

Keywords: sugar,thermal,image processing, diabetes,classifiers

INTRODUCTION

Digital image processing is always an interesting field as it gives improved pictorial information for human interpretation and processing of image data for storage, transmission and representation for machine perception. Image processing is a technique to enhance raw images received from cameras/sensors placed on satellites, space probes and aircrafts or pictures taken in normal day-to-day life for various applications. This field of image processing significantly improved in recent times and extended to various fields of science and technology. The image processing mainly deals with image acquisition, image enhancement, image segmentation, feature extraction, image classification.

Image processing is now routinely used by a wide range of individuals who have access to digital cameras and computers. With a minimum investment, one can readily enhance contrast, detect edges, quantify intensity, and apply a variety of mathematical operations to images. Although these techniques can be extremely powerful, the average user often digitally manipulates images with abandon, seldom understanding the most basic principles behind the simplest image-processing routines. Although this may be acceptable to some individuals, it often leads to an image that is significantly degraded and does not achieve the results that would be possible with some knowledge of the basic operation of an image-processing system.

Vision is the most dynamic of all our senses since it provides us with a huge amount of information about what surrounds us. It is not surprising that an ancient Chinese proverb that quotes: "A picture is worth a thousand words" is still widely used. All this information is valuable for simple procedures (for example planning our everyday activities), but also for more complex processes as the development of our intelligence. At the level of social organization, images are also important as a means of transmitting information, and almost all of today's media are based on our vision. The huge amount of visual information and the need for its processing, lead scientists and technicians towards research in order to discover a means for digital image storage and processing using computers. This effort resulted in a new

Information Engineering Industry called "Image processing and Analysis". This industry began to grow fifteen years ago. However, it has shown a dynamic development, especially during the most recent years and it is considered a science and technology with a promising future and many potential.

RELATED WORKS

Priyanka .R and Shubashri .G were discussed about "automated detection of diabetic foot using thermal images by neural network classifiers" as Infra red thermography is a promising modality for such a system from which diabetes is noninvasively detected using the thermal foot images.The temperature difference between corresponding areas on feet are the clinically significant parameters.the thermal images are preprocessed ,segmented using k-means clustering and then the textural features (GLCM)are extracted and then classified using classifiers. In this paper, to diagonize diabetic foot, three models like probabilistic Neural Network(PNN),K-nearest Neighbour Network(KNN)and support vector machine(SVM) are described and their performances ae compared. Experiment results show that KNN has an accuracy of 95.66% this infers that KNN model outperforms the other two models.

Praful pia and Sanki were discussed about "Cloud computing-based non-invasive glucose monitoring for diabetic care" as Near infrared photoacoustic spectroscopy is utilized for the development of a continuous non-invasive glucose monitoring system for diabetics. A portable embedded system for taking photoacoustic measurements on tissues to estimate glucose concentration is implemented using field programmable gate array (FPGA). The back-end architecture for high-speed data acquisition and de-noising of photoacoustic measurements operates at 274.823 MHz on a Xilinx Virtex-II Pro FPGA. The glucose measurement technique is verified in vitro on glucose solutions and in vivo on tissues, with photoacoustic signal amplitude varying linearly with sample glucose concentration. A kernel-based regression algorithm using multiple features of the photoacoustic signal is used to estimate glucose concentration from photoacoustic measurements. The calibration algorithm provides a superior performance over previous efforts with a mean absolute relative difference of 8.84% and Clarke

Error Grid distribution of 92.86% and 7.14% over Zones A and B of the grid. A cloud computing platform for automated monitoring of blood glucose levels is proposed to enable individuals with diabetes to connect with doctors and caretakers. The developed system is connected to the cloud service using a mobile device, which facilitates implementation of computationally intensive calibration tasks and the storage and analysis of measurement data for treatment and monitoring.

S.Kavitha and A.Senthil Kumarwere discussed about "Neural network approach for non-invasive detection of hyperglycemia using electrocardiographic signals" as Hyperglycemia or high blood glucose (sugar) level is a common dangerous complication among patients with Type 1 diabetes mellitus (T1DM). Hyperglycemia can cause serious health problems if left untreated such as heart disease, stroke, vision and nerve problems. Based on the electrocardiographic (ECG) parameters, we have identified hyperglycemic and normoglycemic states in T1DM patients. In this study, a classification unit is introduced with the approach of feed forward multi-layer neural network to detect the presences of hyperglycemic/normoglycemic episodes using ECG parameters as inputs. A practical experiment using the real T1DM patients' data sets collected from Department of Health, Government of Western Australia is studied. Experimental results show that proposed ECG parameters contributed significantly to the good performance of hyperglycemia detections in term of sensitivity, specificity and geometric mean (70.59%, 65.38%, and 67.94%, respectively). From these results, it is proved that hyperglycemic events in T1DM can be detected non-invasively and effectively by using ECG signals and ANN approach.

Shubashini Kand MaryLivisa were discussed about "Automatic diabetic detection by using foot path images" as Support vector machine (SVM) - based wound classification method. Although the SVM classifier method led to good results on typical wound images, it is not feasible to implement the training process and the feature extraction on current Smartphone's due to its computational demands. The supervised learning algorithm requires a large number of training image samples and experienced clinical input, which is difficult and costly. To convert an ordinary Smartphone into a practical device for

self- management of diabetic wounds, we need to address two tasks like develop a simple method for patients to capture an image of their foot ulcers and design a highly efficient and accurate algorithm for real-time wound analysis that is able to operate within the computational constraints of the Smartphone

D.Ajith Kumar and PS Anu Shalini were discussed about "Non-invasive ultra-wide band system for reliable blood glucose level detection" as Diabetes is a silent killer and rapidly increasing global epidemic worldwide. Change in life style and healthy diabetes diet are the only remedy as this cannot be cured permanently. Checking blood glucose regularly is crucial to diabetes management. Present way of measuring through glucometer where a blood sample is drawn by pricking fingertip and analysis. This invasive painful process cause discomfort to patient. To overcome this distress a non-invasive patient friendly device is in demand. This article presents an Ultrawide band (UWB) microwave technology with artificial intelligence (AI) based system to detect blood glucose level non-invasively (i,e.. without taking any blood sample). A pair of micro strip patch bio-antenna and an artificial neural network (ANN) with signal acquisition and processing interface was used to setup this system. Centre frequency of 4.7 GHz was transmitted through one side of left hand and forward scattering waveform were received from other side. Characteristic features were extracted from received waveform which was used for pattern recognition and detection process in ANN. The system demonstrated 82% correctness to detect glucose level in blood plasma. It has displayed a consistent and reliable result. Besides it is easy to use, safe and cost effective to end user.

Angelin.P was discussed about "Infrared thermal imaging for interpreting complications of diabetic foot ulcers" as Diabetic foot ulcer is one of the most frequent complications of diabetes. The inevitable need for early detection and effective management is essential, with increasing hospitalizations worldwide. This study proposes usage of Infrared thermal imaging technique as a pre-diagnostic tool for early interpretation of the temperature variations of diabetic foot ulcers. Material and methods: We conducted a three month retrospective case-control study using a high resolution Infra-red Thermoscan. A total of hundred subjects were recruited and divided into

Diabetic and Control groups. The study involved collecting plantar thermal images of all subjects, which were analysed and compared to interpret the temperature variations during ulceration.

Pratheep .M and Damas.S were discussed about "Early diagnostic of diabetic foot using thermal images" as The general objective of the thesis relies in the domain of diabetic foot and follows the two already mentioned research directions: improve the early diagnosis of diabetic foot and reduce ulcers occurrence in diabetic foot. It will be based on the analysis of IR thermal images of the plantar foot. The possible directions are twofold:

• Find new strategies to improve the early diagnosis of diabetic foot in hospitals from the analysis of thermal images,

• Design and test a at home system to monitor foot temperature using an IR camera.

The second objective will require the development of a dedicated system using an IR camera to measure the temperature of the plantar surface at home. Developing and testing such a device in a very limited time is a difficult issue. It was not chosen here. This work will be mainly devoted to the first objective and the thesis is entitled

Sasyapradhan and Mahesh Kariyappa were discussed about "Diabetic foot ulcer mobile detection system using smart phone thermal camera" as Nowadays, the whole world is being concerned with a major health problem, which is diabetes. A very common symptom of diabetes is the diabetic foot ulcer (DFU). The early detection of such foot complications can protect diabetic patients from any dangerous stages that develop later and may require foot amputation. This work aims at building a mobile thermal imaging system that can be used as an indicator for possible developing ulcers.

Methods: The proposed system consists of a thermal camera connected to a Samsung smart phone, which is used to acquire thermal images. This thermal imaging system has a simulated temperature gradient of more than 2.2 °C, which represents the temperature difference (in the literature) than can indicate a possible development of ulcers. The acquired images are processed and segmented using basic image processing techniques. The analysis and interpretation is conducted using two techniques: Otsu thresholding

technique and Point-to-Point mean difference technique.

EXISTING SYSTEM

The new patch is used to detect the level of glucose. The patch uses the patient's sweat to detect the glucose level. The recent research says that the amount of glucose in blood is accurately equal to the amount of blood glucose. The patch uses the diabetes drug metformin. It delivers the drug into the skin. Thus the drug which in turn reduces the level of blood sugar[11]. Cloud computing for detecting the blood glucose level based on non-invasive glucose monitoring is a recent work which is also a very effective method for self-monitoring of glucose level and also for continuous glucose monitoring system by directly connected to the physicians in their mobile phone[14].Diabetes can also be detected using the patient's impression picture by using different picture preparing strategies.[13] There is also a another work using Infrared Thermal Imaging for analysing the diabetic foot ulcers. In this method SPSS statistics version 20.0 software is used to analyse and interpretation of data. The tools like, standard(SD) deviation, mean & student t-test was used. The data has been represented in the table forms, bar graphs and pie charts.

PROPOSED SYSTEM

In this project, our aim is to detect the glucose level of an individual using the thermal images of the palm. Here we use Mid infra-red rays to detect the glucose level instead of Near infra-red rays because near infra-red light interacts with a number of acids and chemicals in the skin which makes it toxic. Hence Near Infrared rays is not suitable for detecting the sugar level. Thermal cameras capture the total amount of heat radiating by the particular object. The colour of the object in the captured picture depends on the amount heat radiated around that particular object.

All objects will emit a few kind of infrared radiation. Also it was one of the ways that heat is transferred. The hotter an object will be more infrared radiation produced. Thermal cameras can detect this radiation and convert it to an image that we can interpret and see with our eyes.

Inside the thermal camera, there are a group of small measuring devices that will capture infrared radiation, called micro bolometer which accounts the temperature and then consigns that pixel to an appropriate colour. Most thermal cameras captures longer wavelength of infrared and the general typical night vision security camera witness shorter wavelength of infrared. Thermal compression has the capability to capture longer wavelengths of infrared and also allowing detecting heat. Insulin will seems to work as an internal thermostat and facilitate to raise core body temperature by trigger the burning of "brown fats" cells. Many type1 diabetes have a low core body temperature that is below 97degree whereas the type2 diabetes warm a body rather than cooling it. Since, body temperature depends on the level of glucose in the body it is possible for us to detect the sugar level using thermal camera which produce images depending on the temperature.

Temperature	Colors in thermal image
Colder	Blue,purple,green
Warmer	Red,orange,yellow

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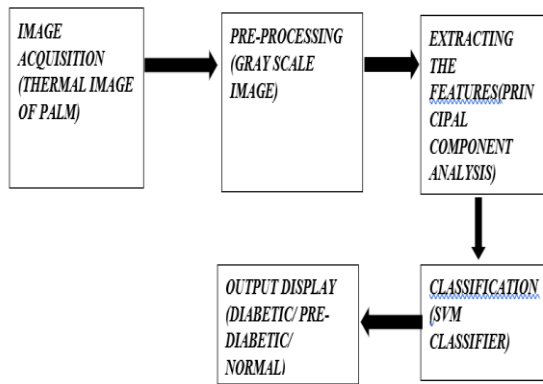
Fig.1 System architecture

A system's architecture can provide a plan from which products can be procured, and systems developed, that will work together to implement the overall system.

The thermal image of the palm will be acquired first.Then the thermal image is subjected to four levels of processing.The thermal image is pre processed first by converting it into a gray scale image. Because will understand the gray scale image better, rather than the raw thermal image. The features or the points where glucose level affected is identified. Then the SVM(support Vector Machine) classifier is used for classification and then segmented. Since SVM is the better classifier for supervised learning, it is used in this project for better results.

Image classification analyzes the numerical properties of various image features and organizes data into categories. Classification algorithms typically employ two phases of processing: *training* and *testing*. In the initial training phase, characteristic properties of typical image features are isolated and, based on these, a unique description of each classification category, *i.e. training class*, is created. In the subsequent testing phase, these feature-space partitions are used to classify image features.

The description of training classes is an extremely important component of the classification process. In supervised classification, *statistical* processes (*i.e.*based on an *a priori* knowledge of probability distribution functions) or *distribution-free* processes can be used to extract class descriptors. Unsupervised classification relies on *clustering* algorithms to

automatically segment the training data into prototype classes

After extracting the features, the grey scale image is classified using classifiers. The classifiers like Support Vector Machine (SVM), Probabilistic Neural Network (PNN), K-Nearest Neighbour Network (KNN) are used to diagnose the thermal images of palm. In this project we are using support vector machine (SVM) as the classifier. Because support vector machine (SVM) is suitable for supervised learning than other available classifiers

CLASSIFIER TYPE	ERROR	ACCURACY
Support vector machine	14.6%	85.4%
Probabilistic neural network	25.4%	74.6%
K nearest neighbour network	18.8%	81.2%

Table 1. Classifier results

CONCLUSION

Detecting the glucose level using thermal image can bring new revolution in the sugar level detection. In the initial stage, invasive methods are used which can be banded by non-invasive methods like patch methods, ray passing methods etc. In this method, we use thermal images to detect the sugar level which makes the sugar patients free from fringe pricking method. Initially only the near infrared rays are used to detect the sugar level, in this we use middle infrared rays because it gives accurate result than using near infrared rays. SVM, PNN,KNN classifiers are used to verify the accuracy of blood-glucose level by comparing the results of the thermal images obtained.

FUTURE ENHANCEMENTS

In future the project can be extended by the additional use of Thermal cameras available. Also the images obtained by the normal cameras can be converted into a thermal image and it can be processed to get the result of the blood glucose level.So that the patient or the individual can check the diabetic level on daily basis.

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