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GLUCOSE CONTENT ANALYSIS USING IMAGE PROCESSING AND DEEP LEARNING

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***Abstract*—** This research explores a non-invasive approach to glucose content analysis by leveraging image processing and Convolutional Neural Networks (CNNs). Traditional glucose monitoring methods often necessitate invasive procedures, posing potential risks to the immune system, particularly with repeated injections. To mitigate these concerns, the study concentrates on a non-intrusive method utilizing urine samples for glucose testing. The proposed methodology incorporates image processing techniques such as Gaussian filter and image resizing, optimizing the input data for a CNN. Deep learning, particularly CNNs, is employed for its capability in feature extraction and pattern recognition. The system aims for high accuracy in classifying glucose levels into categories such as diabetes, pre-diabetes, and normal, offering a reliable and non-invasive alternative to conventional glucose monitoring techniques. This innovative approach holds promise for improving patient compliance and overall health monitoring in individuals requiring regular glucose assessment.

Keywords: Glucose, gaussian filter, Convolutional Neural Network, Classification, Deep learning Technique and Accuracy.

I. INTRODUCTION

In recent years, the field of medical diagnostics and healthcare has witnessed a significant leap forward with the integration of advanced technologies such as image processing and deep learning. Among the numerous applications of these technologies, one area of paramount importance is the analysis of glucose content, which plays a vital role in monitoring and managing diabetes and other metabolic disorders. Traditionally, glucose level analysis involved invasive methods, but with the advent of non-invasive imaging techniques, a new realm of possibilities has opened up, providing safer and more convenient solutions for patients.

This paper delves into the fascinating realm of glucose content analysis using image processing and the powerful Convolutional Neural Networks (CNN).

We explore the methodologies employed in this emerging field and examine the potential benefits that this innovative approach offers to both healthcare practitioners and patients.

II. RELATED WORK

Automatic and real-time detection of dehydration and glucose levels is becoming increasingly popular. Both of which can predict individual's health conditions. In this paper [1], a portable device is developed, integrating the IR Thermal sensor of AMG 8833 series, which is used for self-health monitoring in real-time. The aim of proposed study is to conduct a non-invasive approach to identify the dehydration and glucose level based on temperature from urine specimens. In addition, the measured parameters of temperature can be visualized in Matlab with a heat map distribution. The results presented that when the body was dehydrated and given a sweet supply, the urine temperature increased by a few degrees. Furthermore, the health care settings would benefit from a correlation between dehydration and urine glucose levels, based on these favorable findings.

Diabetes, a rapidly growing chronic disease, affects millions worldwide. Data mining techniques play a crucial role in early detection and prediction. In our review, we explore these solutions, compare techniques, and highlight challenges for future research in glycemic control. In this paper [2], we present a comprehensive review of the state-of-the-

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art in the area of diabetes diagnosis and prediction using data mining. The aim of this paper is twofold; firstly, we explore and investigate the data mining-based diagnosis and prediction solutions in the field of glycemic control for diabetes. Secondly, in the light of this investigation, we provide a comprehensive classification and comparison of the techniques that have been frequently used for diagnosis and prediction of diabetes based on important key metrics. Moreover, we highlight the challenges and future research directions in this area that can be considered in order to develop optimized solutions for diabetes detection and prediction.

This work addresses the increasing number of diabetic patients around the world. Neural network models have been developed and used to predict and classify the likelihood of a person to become diabetic. It presents three models based on neural network for the classification and prediction of diabetes. These models include a feedforward network, a pattern network, and a cascade forward architecture. The performance of the three models is compared in terms of accuracy, sensitivity, and specificity. All models are implemented and tested in MATLAB.[4]

III. EXISTING MEHTOD

By using the Image denoising technique we are denoising our image and then we are going to calculate the feature extraction. Feature extraction can be calculated by using mean, standard deviation, variance, skewness. Then we are going to calculate the feature values and then going to extract the feature of all images and stored in one mat. File and we are assigning the labels to the images and by using the SVM model we are going to classify the images based on features and labels of our images after that we are to predict the output by classifying the features that are trained and stored and input image features.

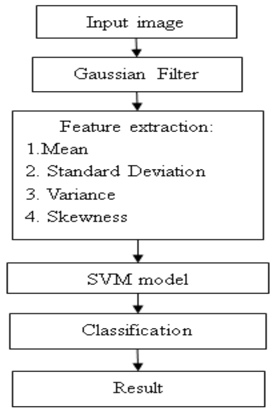

Figure - 1: Block Diagram of Existing Model

Applying a Gaussian filter helps reduce noise and enhances the texture of the image. The typical representation of a gaussian filter is a two-dimensional array [x, y].

V. PROPOSED METHOD

In response to the limitations posed by invasive traditional glucose monitoring methods, which frequently entail repeated injections with potential adverse effects on the immune system, this research proposes a novel methodology for glucose content analysis. Leveraging advanced techniques in image processing and Convolutional Neural Networks (CNNs), the study prioritizes non-invasive glucose testing by utilizing urine samples. The proposed methodology involves key processes such as glucose classification through deep learning, employing tools like Gaussian filters and image resizing to enhance data quality. By circumventing the discomfort associated with invasive procedures, this approach aims to provide a more patient-friendly and accessible means of assessing glucose levels, ultimately contributing to improved healthcare practices and early detection of conditions like diabetes and pre-diabetes.

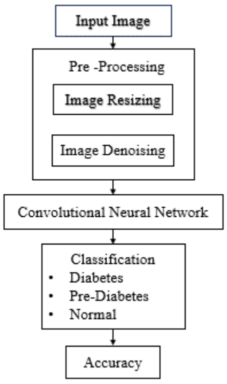

Figure - 2: Proposed Method Block Diagram

a) Pre-processing

Pre-processing in the context of glucose content analysis using image processing and Convolutional Neural Networks (CNNs) refers to a crucial stage where raw input data, in the form of images containing information about urine samples, undergoes various operations to enhance its quality and suitability for subsequent analysis. This preparatory phase involves several key steps, including image resizing to standardize dimensions, which ensures uniformity in data input. Additionally, a Gaussian filter is applied to mitigate noise and improve image clarity, particularly important for accurate feature extraction by the CNN.

b) Image Resize

Image resizing is a fundamental process in image processing that involves altering the dimensions of an image. This transformation can either increase or decrease the size of the image, impacting its resolution and visual representation. In the context of glucose content analysis using image processing and Convolutional Neural Networks (CNNs), image resizing plays a crucial role in standardizing input data. By adjusting the dimensions of the images to a consistent format, the resizing process ensures uniformity in the dataset, facilitating the training and performance of the CNN model.

c) Gaussian filter

A Gaussian filter is a widely used image processing technique employed to blur or smooth images by applying a Gaussian function to each pixel's intensity. Named after the Gaussian distribution, the filter assigns weights to surrounding pixels, with the weights decreasing as the distance from the central pixel increases. This results in a weighted average of neighboring pixel values, producing a smoothing effect.

d) Training Options

SGDM (Stochastic Gradient Descent with Momentum): Specifies the optimization algorithm for updating the neural network weights during training.

Execution Environment: "auto": Automatically selects the available hardware (CPU or GPU) for training the neural network, optimizing computation resources.

Initial Learn Rate: 0.001: Sets the initial learning rate for the optimization algorithm, determining the step size in weight updates during training.

Max Epochs: 100: Specifies the maximum number of training epochs, i.e., the number of passes through the entire training dataset.

Minibatch Size: 25: Defines the number of samples in each mini-batch, controlling the frequency of weight updates and impacting training efficiency.

Shuffle: "every-epoch": Specifies that the training data should be shuffled before each epoch, preventing the model from memorizing the order of the data.

Validation Data: augimds Validation: Sets the validation dataset used to monitor the model's performance during training, aiding in preventing overfitting.

Validation Frequency: 50: Determines how often to evaluate the validation set, here after every 50 mini-batches.

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Verbose: true: Enables the display of detailed information about the training progress.

Plots: "training-progress": Requests the generation of training progress plots, providing visual insights into the model's performance over epochs.

VI. RESULTS

Figure – 3: Input Image

Figure – 4: Resize Image

Figure – 5: Filtered Image

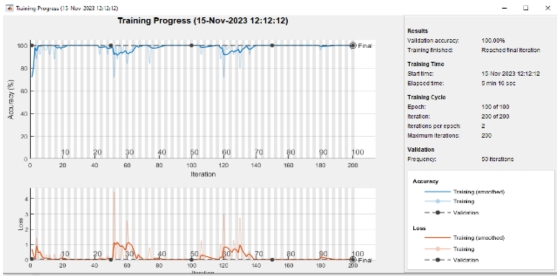
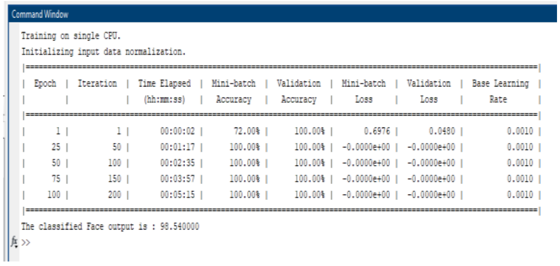


Figure – 6: Training Progress



Command Window

Training on single CPU.
Initializing input data normalization.

Epoch	Iteration	Time Elapsed (hh:mm:ss)	Mini-batch Accuracy	Validation Accuracy	Mini-batch Loss	Validation Loss	Base Learning Rate
1	1	00:00:02	72.00%	100.00%	0.6976	0.0480	0.0010
25	50	00:01:17	100.00%	100.00%	-0.0000e+00	-0.0000e+00	0.0010
50	100	00:02:35	100.00%	100.00%	-0.0000e+00	-0.0000e+00	0.0010
75	150	00:03:57	100.00%	100.00%	-0.0000e+00	-0.0000e+00	0.0010
100	200	00:05:15	100.00%	100.00%	-0.0000e+00	-0.0000e+00	0.0010

The classified Face output is : 98.540000

Figure – 7: Training Iterations and Accuracy

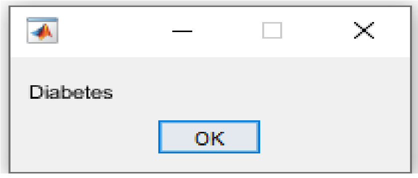


Figure – 8: Classification Using Dialog Box

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Table - 1: Comparison Between Existing Method and Proposed Method

S. No	Existing Method	Proposed Method
1	88.46	98.54
2	88.46	98.54
3	88.46	98.54
4	88.46	98.54
5	88.46	98.54

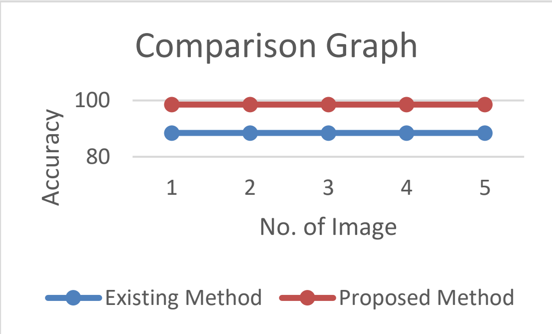

Figure – 9: Comparison Graph

CONCLUSION

In conclusion, the integration of image processing and Convolutional Neural Networks (CNNs) for glucose content analysis, employing techniques such as Gaussian filtering, image resizing, and deep learning, presents a promising avenue for revolutionizing glucose monitoring. By prioritizing non-invasive urine samples over traditional invasive methods, the research addresses concerns related to patient discomfort and potential immune system impact. The emphasis on accuracy and classification into diabetes, pre-diabetes, and normal categories showcases the potential for early detection and improved patient outcomes. This innovative approach not only mitigates the drawbacks of invasive procedures but also sets the stage for a more accessible, patient-friendly, and precise method of assessing glucose levels, contributing significantly to advancements in healthcare technology and diagnostics.

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