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# Remote healthcare systems for diabetes diagnosis : A bio-inspired deep learning approach using NCA-CNN

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**Abstract**

The development of healthcare systems has been greatly enhanced by recent advances in the IoT and AI, especially machine learning technology, which will now be used to prevent, diagnose and treat patients they have been monitored remotely and in the comfort of your home so This study focuses more on in-depth learning about building remote health care systems for diagnosing diabetes. Both the speed of data processing and the accuracy of detection are enhanced in the proposed system. The two steps in the hybrid deep learning approach (NCA-CNN) method present are as follows: First, significant features are selected from all data, then selected features are classified in NCA algorithm is a statistical method that selects important features and scores features based on data analysis findings. Subsequently, the variable depth of tissue classifies the most dramatic features, leading to more accurate diagnosis. The evaluation results show that the accuracy of the proposed method is 96.88%.

***Subject Classification:*** *68T07, 92C50, 92C45.*

***Keywords:*** *AI, Deep Learning, Diabetic, IoT.*

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## 1. Introduction

Internet of Things (IoT) technologies and applications have increased in sophistication in recent years, allowing online connectivity of a large number of devices in domains such as home automation, industrial manufacturing, health etc. Many apps have been developed in smart health [1]. The importance of mobile health services is increasing due to the use of the Internet as it is very important in the monitoring and management of patients with chronic diseases such as diabetes and cardiovascular diseases this is a consequence of the importance of mobile applications [2]. We've found that patient data is really useful when it comes to smart health and patient management in particular. An Internet Resource system for use in this area should record a wealth of information gathered by analyzing a patient's clinical symptoms that can be analyzed to identify those in need of "preventive care" and provide they have stopped the progression of their disease. In order to protect their own lives and enhance their overall health, some patients must provide confidential personal information [3].

## 2. Literature Survey

Timely diagnosis and management of diabetic conditions are essential to prevent complications such as cardiovascular diseases, renal failure, arthritis, and eye disease. Traditionally, the diagnosis of diabetes requires clinical tests such as blood glucose measurement, oral glucose tolerance test (OGTT), and HbA1c analysis [4]. However, these trials require patients to travel to health care facilities, which can be inconvenient, expensive and resource intensive. With the rise of telemedicine, mobile health (mHealth), and wearable devices, remote healthcare systems have emerged as promising alternatives replacing conventional diagnostic methods, allowing patients to manage their health and receive tests and treatments from the comfort of their homes.

Deep learning, a subset of machine learning, has shown tremendous potential in healthcare, particularly in medical image analysis, predictive modeling, and diagnostic automation. Convolutional Neural Networks (CNNs): CNNs are widely used in healthcare for processing medical images, including retinal images for diagnosis of diabetic retinopathy or scans associated with diabetes causes such as arthritis or heart and neurological CNNs have shown effectiveness in extracting certain features from unstructured data [5].

Neighborhood Component Analysis (NCA) is a supervised feature selection method for identifying highly discriminatory features from datasets. The NCA in the diagnosis of diabetes can be helpful by selecting the most appropriate features from several physiological parameters, including blood glucose levels, heart rate, functional data, and demographic information [6].

NCA for diabetes risk prediction: In diabetes risk prediction system, NCA has been used to select important features from health data such as blood pressure, cholesterol level, glucose level etc. This for statistics reduces costs and increase overall forecasting performance [7]. Hybrid NCA-CNN models: By combining NCA and CNN, researchers can benefit from both efficient feature selection and powerful image classification capabilities. NCA makes selective features, while CNN trains a deep neural network capable of accurately predicting diabetes diagnosis, complications and progression using the selected features.

**4. Proposed Research**

This section will describe our proposed machine learning approach for diabetes diagnosis as described in Figure 1. The components of online diabetes diagnosis and management include the following: 1) data collection; 2) data analysis; and 3) decision-making by uploading information to a cloud computing platform after data analysis and the Internet of Things. The data analysis phase of this process is important because incorrect data analysis will result in incorrect decisions and major issues for the entire system. Therefore, there is a need to provide an approach based on machine learning and artificial intelligence for accurate data analysis and more accurate decision making [8].In the clinical domain, the internet of things is critical to improving patient compliance with medication regimens. This is a common problem when not taking medication as prescribed leads to poor health and increased medical costs. Concerns about patient privacy and data security need to be addressed when using this technology to protect patient data and maintain compliance with appropriate health care standards. In total, there are 768 specimens in this database, with 9 columns. The first eight columns list the patient characteristics, and the last column lists the diagnosis. Please see Table 1 for details on feature specifications. The purpose of this procedure is to aims to map data points to a low-level aggregation of those from the same class and to divide the classes into more general classifications. One of the main uses of in this way is the distribution

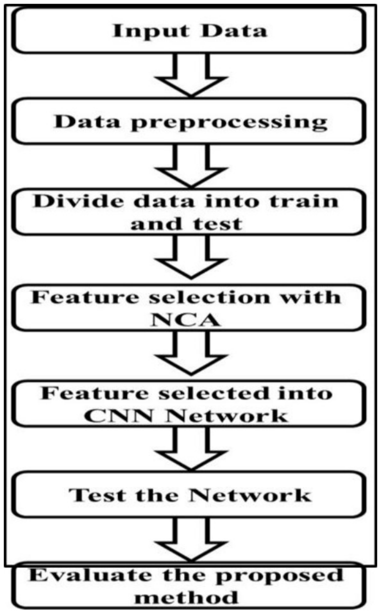


**Figure 1**

**Working Methodology**

system. These methods include linear classifiers and K-nearest neighbors (KNN) [9]. It requires a linear feature shift that will increase similarity between existing such data points (those in the same class) and reduce the similarity between already dissimilar data points (those in different classes). Define this as an optimization problem aimed at maximizing a stable objective function. Increasing the price of the targeted research can help achieve this. The transformation matrix has been adjusted throughout the optimization process to find the best linear transformation.

In the case of supervised learning, the selected network is assigned a set of features and their labels (i.e. intended class), during the training phase the network searches for appropriate statistical patterns between features and their labels [10]. Furthermore, there are cases where certain characteristics not only hinder the search for an optimal model but also make it more difficult. In this work, we determine the weights of input data features using the NCA method, and we excluded features with weight 0. This effort shortens the time required for correlation training, and at the same time improves the detection accuracy. This section examines the proposed method. Two scenarios are illustrated in this section. In the first case, the NCA method is not used for feature selection,

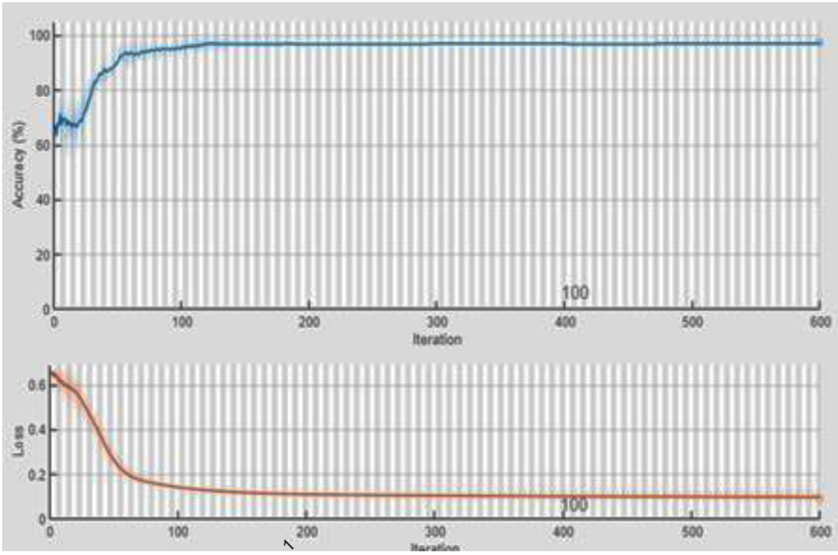


**Figure 2**

**NCA- CNN Hybrid Training and error graph**

but in the second case, the NCA method is used for optimal feature selection. Finally, the accuracy of diagnosing patients with diabetes is compared with other diagnostic methods. It should be noted that MATLAB software version 2021 was used for each simulation in this work. Naturally, these number results from running the program only once; thus, to provide a fair comparison, an average must be obtained from several running operations. In this article, we apply the NCA algorithm to determine optimal attributes. The first, fourth, and sixth attributes of the eight items belonging to this database are less important than the other items and for this reason we examined items 2, 3, 5, 11, 7, and only in 8, which is now included in the proposed CNN network. The full set of training and error diagrams along with the proposed network for which the NCA method is evaluated in Figure 2.

The confusion matrix of the proposed method (using the NCA algorithm) for classifying all types of diabetic and healthy patients showed in Figure 3. In one run it turned out to be 98.1% accurate. The comparative accuracy of the methods for the model graph is given in the next section. The power of transformation networks is based on their ability to detect objects between layers. To accurately represent information by neural networks, it also requires a large number of training data and parameters.

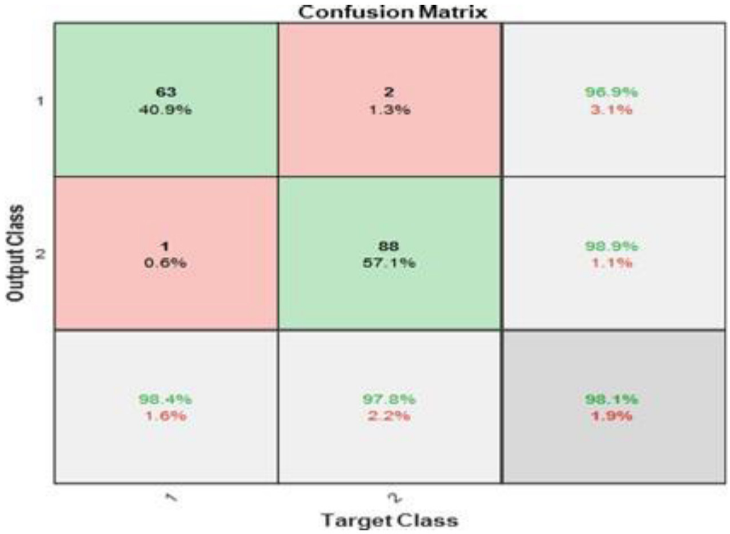


**Figure 3**

**NCA- CNN Hybrid Confusion matrix**

CNN uses presentations in their curriculum. The last layer passes the network faults to the first layer to reduce the faults and update the load.

4.1 *Comparing the outcomes*

The accuracy of diagnosing diabetes using our suggested approach and the methods of the reference article are compared in Table 1. The accuracy for the suggested approach shown is the average of 50 separate runs of the simulation software.

**Table 1**

**Comparison Analysis**

| Method | Accuracy |
|---|---|
| Naïve Bayes | 84.92 |
| Random Forest | 95.97 |
| OneR | 69.99 |
| SMO | 90.01 |
| Proposed method(CNN) | 95.91 |
| Proposed method (NCA-CNN) | 96.88 |

## 5. Discussion & Conclusion

Remote health systems for diabetes diagnosis are rapidly developing, with bio-inspired deep learning approaches such as NCA and CNN showing great promise to improve diagnostic accuracy and efficiency When combined with NCA feature selection power and CNN's image classification capabilities , these hybrid models can handle complex health data and disease Despite challenges such as data quality, model interpretability, and real-time processing that provides timely predictions of trends, challenges, and effective management strategies, a future of hybrid deep learning in health care systems with remote control is promising, and continued R&D is likely to further improve diabetes care. Our main goal in this work is to diagnose diabetes by employing a remote medical monitoring system in conjunction with deep learning. Using every feature of the collected data in the proposed method would be very computationally expensive.

## 6. Acknowledgement

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