





***RESEARCH ARTICLE***

**Short Review for Medical Diagnosis of Diabetics using Back Propagation and Expert system Algorithm in Artificial Neural Networks**

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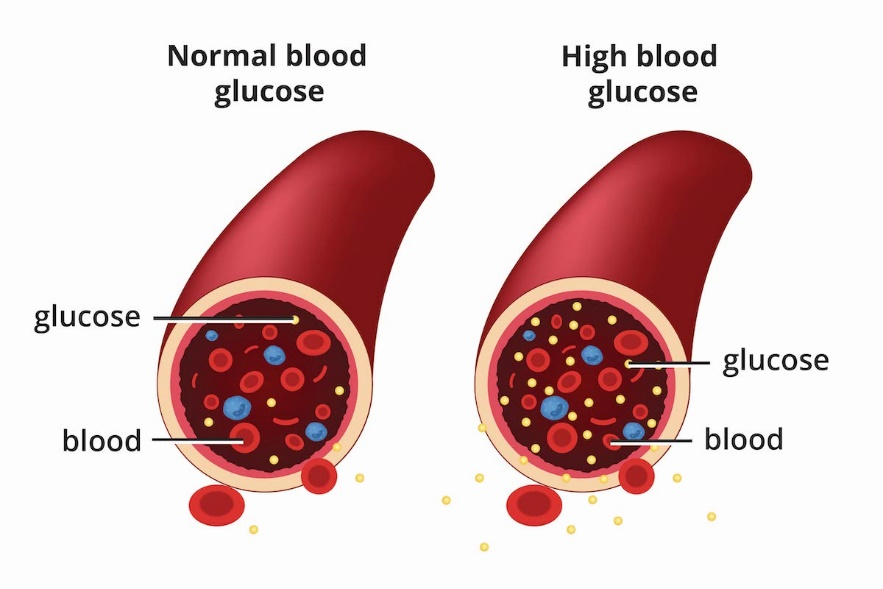
| **Article Info.** | **Abstract** |
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| *Article history:*  Received  Accepted | This review paper examines the application of back propagation and expert system algorithms in artificial neural networks for the medical diagnosis of diabetes. With the high prevalence of diabetes worldwide, timely diagnosis of addiction is essential for effective control. Network of Networks has a promising, cutting-edge, and medically-focused approach to this field. An overview of current state-of-the-art designs and monetary values will follow the major strengths of the system's expert algorithms. In this paper we will discuss issues related to data availability, interpretation, and scalability, and explore potential future directions. This review paper serves as a valuable resource for researchers and healthcare professionals interested in leveraging artificial neural networks for the diagnosis of diabetes, facilitating advancements in this critical field of study  2019 Middle Technical University. All rights reserved |
| **Keywords**: Back propagation, diagnosis, diabetes, | |

**1. Introduction**

Artificial intelligence techniques, particularly artificial neural networks, have emerged as powerful and innovative tools in the field of diabetes diagnosis. Rapid and accurate diagnosis of this prevalent disease is crucial for improving patient care and effectively managing the condition. The application of artificial neural networks in diabetes diagnosis offers a promising approach that can enhance diagnostic accuracy and improve treatment outcomes.

This study aims to review recent research articles focused on the use of artificial neural networks in diabetes diagnosis. These studies will be critically evaluated in terms of the methodology employed and the results obtained. Additionally, we will explore the challenges facing the use of artificial neural networks in this field and potential future developments.

A range of reliable and diverse scientific sources will be presented to support the content and analysis. These sources will be arranged according to their importance and availability to enhance a comprehensive understanding of the research topic. These articles can serve as valuable resources for experts and researchers working in the field of diabetes diagnosis using artificial neural networks and healthcare in general.



| **Nomenclature** | **CNN:** Convolutional Neural Network |
| --- | --- |
| **SHLN**  Single-Hidden-Layer Neural Network | **BGL:** Blood Glucose Level |
| **RDA:** Reverse Diffusion Algorithm | **HRV:** Heart Rate Variability |
| **SENS:** Sensitivity | **SVM:** Support Vector Machines |
| **DT:** Diabetes Types | **GT:** Genetic Techniques |
| **BNN:**  Backpropagation Neural Network | **DM:**  Diabetes Mellitus |
| **ANNs:**  Artificial Neural Networks | **GE:** Genetic Evolution |
| **BPNN:**  Backpropagation Neural Network  **MLA:** MATLAB  **FL:** Fuzzy Logic  **NNT:**  Neural Network TuningPEV  **AD:** Accuracy of Diagnosis  **DAs:**  Different Algorithms  **DC:** Diabetes Classification  **HA:** High Accuracy | **CCVD:** Chronic Causes of Cardiovascular Disease  **NIBR:** Non-Invasive Blood Sugar  **IEMC:**  Improved Early Medical Conditions  **BN:** Batch Normalization  **BD:** Better Detection  **ECG:**  Electrocardiogram  **NSDM:**  No Specific Drawbacks Mentioned |

**2. Literature Review**

**Ambilwade et al[1].** The AI method used a single-hidden-layer neural network with a reverse diffusion algorithm for diabetes diagnosis based on real-time data. It aimed to reduce time-consuming medical tests and costs. The goal was to develop a system that predicts diabetes based on specific input criteria. A causal neural network model with 16 line layers, 17 uniques, and one output layer, using data from 75 patients.. A diagnostic system of 87.2% was obtained for diagnosing diabetes with an incidence of 80.3% and a specificity of 87.3%.. It offers real-time assistance in diagnosing diabetes but isn't designed for other diabetes types or providing treatment.

**Gupta et al[2]**.A study used the back propagation neural network model as a classifier to differentiate individuals from others in the field of medical diagnosis using artificial networks (ANNs). ANNs are widely utilized in medical diagnostics, addressing acute and mild health issues. The research aimed to assess the efficacy of ANNs, particularly for diabetes, blood pressure, and obesity. The study successfully classified patients as affected or unaffected using a forward-backpropagation neural network model trained systematically with UCI Machine Learning Repository data. The neural network model effectively classified patients with diabetes, hypertension, and obesity, showcasing the potential of ANNs in medical diagnostics, while any limitations are not explicitly mentioned.

**Joshi et al.[3]**The research employs the backpropagation neural network (BPNN) in MATLAB for the detection and prediction of diabetes mellitus. The BPNN architecture includes an 8-parameter input layer, a hidden layer with 10 neurons, and an output layer. Utilizing the Levenberg-Marquardt backpropagation algorithm, known for fast convergence, the system aims to overcome accuracy and time limitations in diabetes detection. The goal is to develop a user-friendly software tool for efficient and less invasive diabetes prediction, achieving a reported accuracy of 81%. The proposed BPNN system with the Levenberg-Marquardt algorithm offers improved classification performance and time efficiency, yet the research paper does not explicitly mention any drawbacks or limitations.

**Gupta et al.[4]**The paper explores early diabetes detection using soft computing techniques like fuzzy if-then rules and neural network tuning. Its goal is to create a diagnostic system that reduces output errors and offers initial patient care. The proposed system combines fuzzy logic and neural networks for learning and uses a client-server architecture for solution analysis and storage. Simulation results demonstrate effective early diabetes detection, with the client-server system capable of sending first aid messages. Soft Computing allows a flexible diagnosis approach, and the system efficiently analyzes and stores solutions, providing advice to patients without specifying any drawbacks.

**Adnan et al.[5]**The researchers employed an artificial neural network trained with the reverse diffusion algorithm to enhance the accuracy of diabetes mellitus diagnosis. Diabetes is a chronic metabolic disorder with severe consequences if not managed properly. Existing algorithms for diagnosis lack accuracy. The study utilized a database of Indian diabetes patients and eight traits for prediction. The artificial neural network, trained with the reverse propagation algorithm, achieved an 82% recognition rate, surpassing previous algorithms. The use of this network improved the accuracy of diabetes mellitus diagnosis, and no specific disadvantages are mentioned in the sources provided.

**Jain et al[6]**.The paper introduces an expert system for diagnosing Type I diabetes and recommending insulin dosage using fuzzy logic to handle uncertain information. It considers factors like BMI, plasma glucose levels, and blood pressure. The focus is on the challenges of diabetes diagnosis, particularly for Type I diabetes, aiming to provide accurate results and avoid hypoglycemic states. The system utilizes fuzzy logic, linguistic output, and visualized probability of diagnosis. While specific drawbacks aren't mentioned, the paper emphasizes addressing inaccuracies in diabetes diagnosis through an ambiguity-based expert system.

**Moungmai et al [7].**The paper employed diverse classification models, such as decision tree, artificial neural networks, logistic regression, Naive Bayes, packing, reinforcement, and random forests, for predicting diabetes risk in Thailand. The research aimed to address the increasing concern of undiagnosed diabetes cases, particularly in young individuals and those with obesity. The study's primary goal was to develop and compare predictive models using various algorithms. Utilizing a dataset of 30,122 individuals, including a normal group and a diabetes risk group, the research assessed the performance of different models. Results favored the Random Forest algorithm, leading to the development of a web application for practical diabetes risk prediction. However, the study lacked specific details on individual model performances and omitted discussions on potential limitations or challenges associated with classification models.

**Chiuchisan et al.[8]**Present a hybrid model that uses the Adaptive Neural Inference System (ANFIS) to classify patient populations on a diabetes dataset of Pima Indians. The ANFIS model was implemented using the ANFIS Fuzzy Logic toolbox and the MATLAB toolbox. However, the results indicate a high prevalence of diabetes, and the study focuses on developing an accurate AI model to classify diabetes patients, leading to its contribution to underdiagnosis. The ANFIS model achieved a continuous progress rate of 85.35% for training data and 84.27% for test data, leading to its activities in the category. Despite its success, the ANFIS modeling approach requires significant computing resources and faces challenges in designing large models with numerous sections, rules, and parameters.

**Sowunmi et al.[9]**The research developed a four-layer feed-forward neural network model, using posterior diffusion and a Bayesian organization algorithm, to diagnose diabetes in pregnant women. The model achieved over 92% accuracy in validation, crucial for early detection in pregnancy. The study aimed to create a functional expert system based on a neural network to meet the need for accurate diabetes diagnosis in pregnant women. Early detection is vital for effective treatment. A web-based application was also designed for patient use, ensuring easy access to the model. The research doesn't explicitly mention any drawbacks or limitations of the developed neural network expert system for diabetes diagnosis in pregnant women..

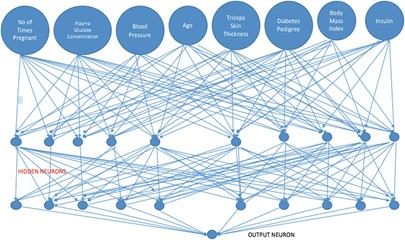


Fig. 1. The neural network model[9]

**Abu-Naser et al.[10]** Researchers used artificial neural networks As a way for artificial intelligence to predict whether a person has diabetes or not Diabetes is a common disease all over the world for which there is no cure, and it costs a huge amount of money to care for people with diabetes The most important issue is to accurately predict diabetes and use a reliable method for this The aim of the research was to predict whether a person has diabetes or not using artificial neural networks The researchers used a front-Fed neural network with one input layer, three hidden layers and one output layer. They used the Backpropagation algorithm to learn and test the neural network. After training the ANN model, the average error function of the neural network was 0.01, and the accuracy of predicting diabetes was 87.3٪ Artificial neural networks are an advance in computing and information processing tools, and they have promising consequences. Feeder neural networks with appropriate activation functions and neurons of sufficient hidden layer can estimate any function with random accuracy No specific disadvantages of using artificial neural networks to predict diabetes have been mentioned in the presented sources.

**Dashtbozorg et al. [11]**The researchers investigated the application of deep residual networks, particularly convolutional neural networks (CNNs), for direct diagnosis of diabetes from retinal images, bypassing the reliance on blood glucose information.. Recognizing the global impact of diabetes and the importance of early detection, retinal images are considered valuable for assessing circulatory system health. The study aimed to determine if CNN networks could accurately discern between healthy and diabetic individuals based solely on retinal images, addressing the challenge faced by human experts. Using deep residual networks, specifically CNNs, the researchers successfully differentiated between healthy and diabetic patients, showcasing superior performance compared to human experts. The proposed method offers a non-invasive, patient-friendly approach to diagnosing diabetes without the need for blood sugar level information, and the study did not identify any drawbacks.

**Nardone et al. [12]**The researchers proposed a machine learning method to classify diabetes patients using WHO criteria-based selected characteristics. They achieved a precision of 0.770 and a recall of 0.775 using the HoeffdingTree algorithm on real-world data. Given the increasing prevalence of diabetes, the aim was to develop an efficient classification method based on selected features and machine learning. The study assessed whether the chosen characteristics could effectively distinguish diabetes patients. The experiment, utilizing descriptive statistics and classification techniques, demonstrated an accuracy of 0.757 and a recall of 0.762 with the HoeffdingTree algorithm. While the proposed method accelerates the diagnostic process, its reliance on WHO criteria-based characteristics may limit its applicability to diverse populations or contexts, warranting further research for validation in different settings.

**Tsave et al. [13]**The paper delves into the application of machine learning and data mining techniques in diabetes research, emphasizing the necessity of intelligent approaches to translate available data into valuable knowledge. The study's goal is to systematically review machine learning applications and data mining techniques in diabetes research, with a focus on prediction and diagnosis, complications, genetic background, environment, healthcare, and management. Through a systematic review of the literature, articles were classified based on their applications in diabetes research, revealing that supervised learning methods, especially support vector machines (SVMs), were the most successful and most widely used algorithms.. Clinical datasets were predominantly employed, with prediction and diagnosis being the most common research category. The utilization of these methods enables the extraction of valuable knowledge, leading to a deeper understanding of diabetes and prompting further investigation. The study does not explicitly point out any drawbacks or limitations associated with the use of machine learning and data mining methods in diabetes research.

**Vinayakumar et al.[14]** Learning algorithms, including LSTM and CNN, are used to classify normal and modified cardiometabolic (HRV) diabetes indices. Deep learning extracts complex time-dynamic features from HRV data, which are then classified using SVM, achieving an impressive 95.7% accuracy in diabetes diagnosis via ECG signals. Traditional machine learning techniques had limitations with high-dimensional data, driving the adoption of deep learning in healthcare. The research aims to improve diabetes detection accuracy using HRV signals, vital for early treatment and complication prevention. The combination of deep learning and SVM layers proves highly effective, outperforming prior non-invasive diabetes detection methods, but the paper does not mention any drawbacks or limitations explicitly.

**Babatunde et al.[15]** The research utilized a combination of genetic techniques, neural networks, and fuzzy logic for diagnosing and managing diabetes mellitus, aiming to create an expert system. It addressed the use of intelligent systems to improve healthcare and reduce treatment costs. The research aimed to determine if combining multiple methods could enhance performance in diabetes diagnosis and management. The methodology involved creating a framework for three intelligent approaches and utilizing production rule-driven reasoning algorithms based on Mamdani's inference mechanism. The study resulted in an expert system for diabetes diagnosis and management using AI technologies, but specific advantages and disadvantages were not mentioned.

**Jain et al [16]**The study assessed the performance of Medios AI, an offline smartphone-based automated retinal image analysis system, in detecting diabetic retinopathy (RDR) This AI system achieved a 100.0% accuracy rate in identifying referable diabetes and displayed a specificity of 88.4%. It also showed a sensitivity of 85.2% and a specificity rate of 92.0% in detecting diabetic retinopathy, compared to evaluations conducted by ophthalmologists.. The research aimed to address the lack of specialized access to diabetic retinopathy screening in remote areas, offering instant results without requiring internet access. Access to ophthalmologists in remote areas is limited, delaying diagnosis and treatment. The study conducted a cross-sectional examination using an offline AI system with a smartphone-based fundus camera, providing a valuable tool for community-based diabetic retinopathy screening. the size of the technical study was larger, and remains small, suggesting a need to read through the research using a larger technique to obtain more generalizable results.

**Kumar et al.[17]**The paper introduces the Associated evolutionary gravity search algorithm (ECGS) for efficient feature selection and the genetically enhanced Hopfield neural network (GHNN) for diabetes-related feature prediction. ECGS optimizes feature selection by analyzing diabetic features through correlation and mutual information, minimizing computational time and cost. It confirms the occurrence of an early decrease in the incidence of diabetes due to its global spread and the risks resulting from it. GHNN effectively processes specific features for diabetes prediction, addressing the challenges of prediction accuracy. The mean study evaluates the performance of the system using various criteria, including squared error, F-measure, accuracy, composite matrix, and ROC curve.. GHNN demonstrates high sensitivity and specificity, outperforming other traditional methods, while ECGS streamlines feature selection and reduces computational overhead. No specific disadvantages are mentioned in the sources provided.

**Sun et al.[18]**A convolutional neural network (CNN) with batch normalization (BN) is used to diagnose vascular diabetes, including chronic causes of cardiovascular disease and vascular diseases.. The CNN model is applied to one-dimensional unrelated datasets, achieving a remarkable 99.85% training accuracy and 97.56% test accuracy, surpassing logistic regression by over 2%. A common complication of diabetes is diabetic retinopathy, the diagnosis of which is usually based on fundus photographs. The study aims to enhance accuracy and speed up the diagnostic process by utilizing the CNN method and BN layer. The main goal is to build a diagnostic model that improves the diagnosis of diabetes and other diseases. Using electronic medical records of 301 hospitalized diabetes patients, the CNN model, combined with the BN layer, achieves impressive accuracy while preventing overfitting and optimizing training. The CNN-BN combination proves effective not only for diabetic retinopathy but also for diagnosing other diseases. No specific disadvantages are mentioned in the sources provided.

**Yilmaz et al. [19]**The paper utilized Adaptive Fuzzy Neural Inference System (ANFIS) along with Principal Component Analysis (PCA) for the diagnosis of Type II diabetes, aiming to enhance diagnostic accuracy. ANFIS, a soft computing method combining fuzzy logic and neural networks, forms the basis of an intelligent diabetes diagnosis system. PCA identifies distinct categories of Type II diabetes themes and controls, presenting their features as inputs to the ANFIS classifier. The study focuses on improving diagnostic accuracy in Type II diabetes, a prevalent and significant disease. The combination of PCA and ANFIS in the diagnostic system holds the potential to enhance diabetes diagnosis accuracy, although specific results and disadvantages are not explicitly mentioned.

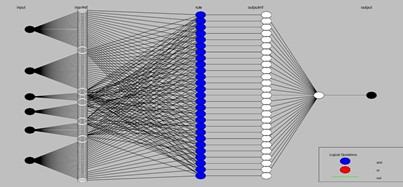


FIGURE . ANFIS structure designed[19]

**Shrinivasan et al.[20]**The paper utilizes the Adaptive Fuzzy Neural Inference System (ANFIS) for diabetes diagnosis, highlighting the need for an effective medical decision support system to predict diabetes early and prescribe appropriate treatments. The research aims to enhance classification accuracy in diabetes diagnosis by integrating an adaptation factor through embedded neural networks with a fuzzy system. The ANFIS-based decision support system is designed to provide better accuracy, and the researchers evaluate its performance using MATLAB's Indian Pima diabetes dataset. Results demonstrate that ANFIS-based classification outperforms other methods, showcasing its potential to improve diabetes diagnosis. ANFIS offers adaptability and improved classification accuracy, making it a promising AI method for diabetes diagnosis, with no specific disadvantages mentioned in the sources provided.

**Zhao et al.[21]**The researchers aimed to develop a Back-Propagation Artificial Neural Network (BP-ANN) optimized with prior knowledge for early diabetic retinopathy (DR) detection, comparing its effectiveness with other methods. They extracted features like vascular width and zigzagging automatically from retinal images to train the BP-ANN with prior knowledge using 240 fundus images. The results showed that the pre-defined BP-ANN achieved superior detection compared to traditional BP and SVM methods. The improved BP-ANN demonstrated a shorter training time and better accuracy, particularly with 20 hidden neurons. Knowledge-based BP-ANN holds promise for early DR detection, and no specific disadvantages are mentioned in the sources provided.

**Computing et al.[22]**The study employed the BP neural network and probabilistic neural network for intelligent diabetes diagnosis using artificial intelligence. It aimed to assist inexperienced doctors and address medical resource disparities. The goal was to model diabetes diagnosis with these networks and compare their performance. The study determined BP network hidden layer modules based on input feature vectors and used a 75% training and 25% testing split for PNN. Experimental results showed a diagnostic accuracy of 91.7% for BP and 97.9 % for PNN. The neural network-based model improved diagnostic efficiency and saved doctors' time compared to traditional methods.

**Alkhamees et al.[23]**The research proposes an improved artificial neural network (ANN) model for effective diabetes prediction, using the ABP-SCGNN algorithm and varying neuron numbers from 5 to 50. ANNs have significantly impacted medical diagnostics, aiming to predict disease presence or absence by analyzing parameters related to diabetes. The study focuses on enhancing the reliability and certainty of diabetes diagnosis and compares the ABP-SCGNN model with other ANN models. The goal is to develop an accurate ANN model for diabetes diagnosis using evaluation criteria like accuracy and mean squared error (MSE). The ABP-SCGNN model with 20 neurons achieved 93% accuracy in diabetes diagnosis, outperforming other ANN models. While the research demonstrates substantial progress in diabetes diagnosis, it doesn't explicitly state any drawbacks or limitations of the proposed ABP-SCGNN model.

**MISHRA et al.[24]**Use a joint model using four different algorithms: Joint Network, K-Nearest Neighbor, Support Vector Machine, and Naïve Bayes, to diagnose diabetes.. They utilized a clustering technique to enhance accuracy by aggregating predictions. The study aimed to develop intelligent systems mimicking human-like behavior, catering to precise and efficient medical diagnosis. They collected data from 400 individuals through questionnaires, trained it with algorithms, and achieved a 98% accuracy in diabetes diagnosis, with the artificial neural network outperforming others at 97.5% accuracy. The aggregation model and technique improved diagnosis accuracy, enabling early-stage patient assessment and timely treatment without specific disadvantages mentioned in the paper.

**3. Design and implementation of a prototype for diabetes screening and diagnosis**

Advancements in Diabetic Diagnosis: Integrating Back Propagation and Expert System Algorithms in Artificial Neural NetworksThe diagnosis of diabetes has witnessed a transformative leap with the integration of sophisticated technologies like Back Propagation and Expert System Algorithms in Artificial Neural Networks (ANNs). This research explores the synergy between these two powerful approaches to enhance the accuracy and efficiency of diabetic diagnostics.Back Propagation, a fundamental technique in ANNs, plays a crucial role in tuning network parameters. This enables the system to learn and adapt, making it adept at recognizing intricate patterns within diabetic datasets. Coupled with Expert System Algorithms, which leverage domain-specific knowledge, the diagnostic process gains an additional layer of intelligence.The amalgamation of these technologies results in a meticulous and efficient diabetic diagnostic system. Back Propagation optimizes the neural network's performance, ensuring it evolves with evolving datasets, while the Expert System Algorithms contribute specialized knowledge, refining the diagnostic precision. This convergence propels diabetic diagnosis into a new era of accuracy and reliability.This research delves into the intricacies of incorporating Back Propagation and Expert System Algorithms, providing a comprehensive understanding of their collaborative impact on diabetic diagnostics. As we navigate the landscape of medical technology, this integrated approach stands as a beacon of progress in the quest for early and precise diabetic detection.

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| Study | **AI Method Used** | **Technique** | **Datasets** | **Accuracy** |
| Gupta et al.[1] | Fuzzy Logic and Neural Networks | Fuzzy if-then rules and neural network tuning | Not specified | Not specified |
| Adnan et al.[2] | Artificial Neural Network | Reverse diffusion algorithm | Database of Indian diabetes patients | 82% |
| Shreevastava et al.[3] | Backpropagation Neural Network | Forward-backpropagation neural network model | UCI Machine Learning Repository data | Not specified |
| Manza et al.[4] | Single-hidden-layer Neural Network | Reverse diffusion algorithm | Data from 75 patients | 87.2% |
| Jain et al.[5] | Fuzzy Logic | Fuzzy logic, linguistic output, visualized probability | Not specified | Not specified |
| Moungmai et al[6] | Decision Tree, ANN, Logistic Regression, Naive Bayes, Random Forest, etc. | Various classification models | Dataset of 30,122 individuals | Not specified |
| Borse et al.[7] | Backpropagation Neural Network (BPNN) | Levenberg-Marquardt backpropagation algorithm | Not specified | 81% |
| Chiuchisan et al.[8] | Adaptive Neural Inference System (ANFIS) | ANFIS Fuzzy Logic toolbox and MATLAB toolbox | Pima Indians diabetes dataset | 85.35% (training), 84.27% (test) |
| Sowunmi et al.[9] | Feed-forward Neural Network | Posterior diffusion and Bayesian organization algorithm | Not specified | Over 92% (validation) |
| Abu-Naser et al.[10] | Artificial Neural Network (ANN) | Front-fed neural network with Backpropagation algorithm | Not specified | 87.3% |
| Dashtbozorg et al.[11] | Convolutional Neural Networks (CNNs) | Deep residual networks | Retinal images | Not specified |
| Nardone et al.[12] | HoeffdingTree algorithm | Machine learning method based on WHO criteria | Real-world data | 75.7% (accuracy), 76.2% (recall) |
| Tsave et al.[13] | Machine Learning and Data Mining | Supervised learning methods, especially Support Vector Machines (SVMs) | Clinical datasets | Not specified |
| Vinayakumar et al.[14] | LSTM, CNN, SVM | Deep learning, SVM | HRV data | 95.7% |
| Babatunde et al.[15] | Genetic techniques, Neural Networks, Fuzzy Logic | Rule-driven reasoning algorithms based on Mamdani's inference mechanism | Not specified | Not specified |
| Jain et al [16] | AI-based Retinal Image Analysis | Medios AI | Not specified | 100.0% (referable diabetes), 85.2% (sensitivity), 88.4% (specificity) |
| Kumar et al.[17] | Evolutionary Gravity Search Algorithm, Hopfield Neural Network | Efficient feature selection, genetically enhanced Hopfield neural network | Not specified | Not specified |
| Sun et al.[18] | Convolutional Neural Network (CNN) with Batch Normalization (BN) | CNN with BN layer | Electronic medical records | 99.85% (training), 97.56% (test) |
| Yilmaz et al. [19] | Adaptive Fuzzy Neural Inference System (ANFIS), Principal Component Analysis (PCA) | ANFIS, PCA | Not specified | Not specified |
| Shrinivasan et al.[20] | Adaptive Fuzzy Neural Inference System (ANFIS) | ANFIS | MATLAB's Indian Pima diabetes dataset | Not specified |
| Zhao et al.[21] | Back-Propagation Artificial Neural Network (BP-ANN) | BP-ANN optimized with prior knowledge | 240 fundus images | Not specified |
| Computing et al.[22] | BP Neural Network, Probabilistic Neural Network | BP neural network, PNN | Not specified | 91.7% (BP), 97.9% (PNN) |
| Alkhamees et al.[23] | Artificial Neural Network (ANN) | ABP-SCGNN algorithm | Not specified | 93% |
| MISHRA et al.[24] | Joint Network, K-Nearest Neighbor, Support Vector Machine, Naïve Bayes | Clustering technique | Data from 400 individuals | 98% (ANN 97.5%) |

**4. Conclusion**

In conclusion, the integration of medical diagnosis techniques through the application of Back Propagation and Expert System algorithms within Artificial Neural Networks (ANNs) represents a significant stride in the realm of diabetic diagnosis. The utilization of these advanced algorithms has shown promising outcomes, contributing to the precision and efficiency of diabetes detection processes.

The back propagation algorithm, with its ability to adjust neural network parameters, enhances the learning ability of the system, allowing for more accurate identification of diabetes cases. Additionally, the incorporation of Expert System algorithms adds a layer of intelligent decision-making, simulating the expertise of healthcare professionals.

The synergy between these algorithms results in a powerful diagnostic tool that not only detects diabetes, but also provides insight into the complexities of individual cases. This technology holds the potential to revolutionize diabetic healthcare by offering timely and accurate diagnoses, facilitating prompt intervention and personalized treatment plans.

Furthermore, the continual advancement of Artificial Neural Networks in medical applications underscores the importance of harnessing the power of computational intelligence for healthcare challenges. As these algorithms evolve, there is a prospect for enhanced diagnostic capabilities, ultimately improving patient outcomes and healthcare efficiency.

However, it is crucial to acknowledge the continuing need to validate and improve these systems through rigorous testing and real-world application.. Continued collaboration between medical professionals, data scientists and technology developers is essential to ensure the reliability and ethical use of such diagnostic tools.. In conclusion, the convergence of medical diagnosis and artificial intelligence, as exemplified in this study, presents a hopeful trajectory for the future of diabetic healthcare.

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