



GUJARAT TECHNOLOGICAL UNIVERSITY

(Established by Government of Gujarat under Gujarat Act No. : 20 of 2007)

ગુજરાત ટેકનોલોજીકલ યુનિવર્સિટી

(ગુજરાત સરકારના ગુજરાત અધિનિયમ ક્રમાંક : ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

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Abstract of the Thesis



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Faculty: Engineering

Discipline/Branch: Computer/IT

Title of the Thesis: Deep Learning Approach for Type 2 Diabetes
Prediction from Clinical Data

Abstract

The early detection of Type 2 Diabetes Mellitus (T2DM) is a critical challenge in healthcare due to its increasing prevalence and associated complications. Accurate prediction models can assist in timely diagnosis and effective clinical decision-making. However, medical datasets often suffer from issues such as missing values, class imbalance, and complex nonlinear relationships, which limit the performance of traditional machine learning approaches.

This research proposes a novel hybrid framework that integrates data-level enhancement and model-level optimization techniques for improved diabetes prediction. The proposed framework consists of two major components. Algorithm-1 focuses on preprocessing and data augmentation, where invalid zero values in clinical features are handled using an age-group-based mean imputation strategy. To address class imbalance, an Adversarial Variational Autoencoder (AAVE) is employed to generate realistic synthetic samples, thereby improving data diversity and representation.

Algorithm-2 introduces a deep learning model based on a Morlet Wavelet assisted architecture with FFT overlap-add convolution (MW-FFT-OAconv). The use of Morlet wavelet activation enhances nonlinear feature extraction, while FFT-based convolution improves computational efficiency. Additionally, a Weighted Mean of Vectors (WMOV) optimization algorithm is proposed to effectively tune model parameters and improve convergence.

The proposed hybrid framework is evaluated using the PIMA Diabetes Dataset and an additional Diabetes Prediction Dataset. Experimental results demonstrate that the proposed approach achieves a classification accuracy of 98.44%, significantly outperforming conventional machine learning models and existing research methods. The confusion matrix

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Ph.D. Programme

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analysis indicates low false positive and false negative rates, highlighting the reliability of the model. Furthermore, cross-validation results confirm the robustness and generalization capability of the proposed framework.

Overall, the proposed approach provides an efficient and reliable solution for diabetes prediction and has strong potential for application in real-world clinical decision support systems.

This PhD thesis helps in developing an accurate, reliable, and interpretable intelligent framework for the early prediction of Type-2 Diabetes Mellitus by integrating advanced data augmentation, efficient deep learning techniques, and metaheuristic optimization. It also contributes to improving predictive performance while addressing challenges such as class imbalance, nonlinear feature learning, and computational efficiency.

OR

This PhD thesis would be useful in supporting healthcare professionals, researchers, and developers in designing intelligent clinical decision-support systems for early diabetes screening. It also provides a foundation for future research on explainable AI, medical diagnosis, and hybrid deep learning models for disease prediction using real-world healthcare data.

List of Publication(s):

- 1) Hitesh B. Patel and Keyur N. Brahmbhatt, "Prediction of type 2 diabetes based on feature augmentation and Morlet wavelet assisted deep learning network with FFT overlap and add convolution", International Journal of Biomedical Engineering and Technology, Volume-47, Issue-3, pp. 259-286, Jan 2025
- 2) Hitesh B. Patel, Keyur N. Brahmbhatt and Mahasweta Joshi, "Data Augmentation Approach for Type-2 Diabetes Prediction and Classification", Indian Journal of Science and Technology, Volume-18, Issue-14, pp. 1096-1104, April 2025
- 3) Hitesh B. Patel and Keyur N. Brahmbhatt, "A comprehensive review of computational intelligence approaches in type 2 diabetes prediction and classification", International Journal of Medical Engineering and Informatics, Inderscience Publication (Accepted; Yet to be published)