Chandigarh Engineering College Jhanjeri
Mohali-140307
Department of Artificial Intelligence and Machine Learning

PROJECT REPORT
ON

AI-Driven Water Quality Prediction For Aquatic Ecosystem Using Deep Learning and Automated Hyperparameter Optimization

Project-I

Department of Artificial Intelligence & Machine Learning
CHANDIGARH ENGINEERING COLLEGE JHANJERI, MOHALI

In partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Artificial Intelligence & Machine Learning

SUBMITTED BY:
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Under the Guidance of
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April 2025

Affiliated to I.K Gujral Punjab Technical University, Jalandhar
(Batch: 2022-2026)

DECLARATION

I Akshat Choudhary hereby declare that the report of the project entitled AI-Driven Water Quality Prediction for Aquatic Ecosystem Using Deep Learning and Automated Hyperparameter Optimization has not presented as a part of any other academic work to get my degree or certificate except Chandigarh Engineering College Jhanjeri, Mohali, affiliated to I.K. Gujral Punjab Technical University, Jalandhar, for the fulfillment of the requirements for the degree of B.Tech in Artificial Intelligence & Machine Learning.

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ACKNOWLEDGEMENT

It gives me great pleasure to deliver this report on Project-I, which I worked on for my B.Tech in Artificial Intelligence & Machine Learning 3rd year, which was titled AI-Driven Water Quality Prediction for Aquatic Ecosystem Using Deep Learning and Automated Hyperparameter Optimization. I am grateful to my university for presenting me with such a wonderful and challenging opportunity. I also want to convey my sincere gratitude to all coordinators for their unfailing support and encouragement.

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(Signature of Student)

ABSTRACT

Accurate water quality assessment is critical for environmental monitoring and public health. This research proposes a deep learning-based classification model for water quality prediction for aquatic ecosystems, leveraging automated hyperparameter optimization via Optuna to enhance accuracy and computational efficiency. The dataset undergoes rigorous preprocessing, including feature standardization with StandardScaler and stratified train-test splitting to maintain class distribution integrity. The neural network architecture consists of three fully connected hidden layers with ReLU activation, batch normalization for training stability, and dropout regularization to mitigate overfitting. Model training employs the Adam optimizer with a dynamic learning rate scheduler (ReduceLROnPlateau). The optimization process tunes key hyperparameters, including neuron allocation per layer, dropout rate, and learning rate, yielding an optimal configuration of 179-104-36 neurons, 0.2586 dropout, and a 0.00999 learning rate. Experimental evaluation using stratified k-fold cross-validation achieves a test accuracy of 98.02%, with high precision, recall, and F1-scores, ensuring robust predictive performance. The trained model is deployed with standardized input processing, enabling seamless adaptation to varying water quality datasets. Compared to conventional models, this AI-driven framework exhibits superior generalization, reduced computational overhead, and improved classification reliability, making it a scalable solution for real-time water quality assessment in IoT-integrated environmental monitoring systems.

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