i-Glove: An Intelligent Glove System Based on Deep Learning to Support Deaf-blind Individuals in Recognizing Banknotes

Abstract: The deaf-blind community faces significant challenges in identifying banknotes due to simultaneous hearing and vision impairments, which complicate their ability to conduct daily financial transactions. Recent advances in Artificial Intelligence (AI)-based assistive technologies offer promising potential to address these challenges. This study presents the "i-Glove," a wearable device specifically developed to assist the deaf-blind community in Bangladesh with accurate banknote identification. The i-Glove is designed to recognize nine common Bangladeshi banknotes (e.g., BDT 20, 50, 100) through a camera module integrated on the palmar side of the glove, which captures real time images of the banknotes. These images are then processed by a convolutional neural network (CNN) model to accurately classify each banknote. Identified notes are translated into unique vibration patterns that are delivered to the user through a shaftless vibration motor embedded in the glove, providing intuitive, non-visual communication. Compared to previous approaches, our model demonstrates superior performance even with a compact dataset, achieving an overall F1-score accuracy of 96.55%, with class-specific precision, recall, and F1-score metrics ranging from 90% to 100%. Additionally, a dedicated application is developed which supports real-time banknote detection and interfaces seamlessly with the glove. The proposed system represents a significant step forward in assistive technology for the deaf-blind community, empowering the users with greater autonomy in financial transactions.

Feature-Enhanced Rainfall Prediction in Bangladesh Using Statistical and Machine Learning Models Integrated with Explainable AI

Abstract: —Rainfall prediction is very important in the fields of agriculture, water resource management, and even predicting natural calamities. However, due to the intricacies associated with predicting rainfall, the traditional forecasting models may face some challenges. The current research seeks to enhance rainfall predictions through the application of Machine Learning (ML) and Explainable Artificial Intelligence (XAI) by performing feature engineering through the addition of new features like Rainfall Lag1, Rainfall Lag2, Rainfall MA3, Month Sin, and Month Cos to the existing dataset. These elements aim to reflect historical trends and seasonal variations. For evaluating performance, this study includes a statistical model, Seasonal Autoregressive Integrated Moving Average (SARIMA), and ML models like Decision Tree Regression (DTR), Random Forest Regression (RFR), Extreme Gradient Boosting Regression (XGBOOSTR), and Support Vector Regression (SVR). After applying 10-fold cross-validation, SVR emerges as the best-performing model by achieving Mean Squared Error (MSE) of 518.3105, Mean Absolute Error (MAE) of 3.0030, Root Mean Squared Error (RMSE) of 20.6821, R-squared (R^2) of 0.9920, and Kling–Gupta Efficiency (KGE) of 0.9770. The outcomes of the study are evaluated using Shapley Additive Explanations (SHAP) and Local Interpretable Model-agnostic Explanations (LIME) in AI, which reflect the need for interpreting those features. The results show that a combination of feature engineering, ML models, and XAI provides a robust model and improves the transparency of rainfall forecasting, which ultimately will make a contribution in the real-world applications.

AI-Driven Prediction of Protein Structural Stability: A Machine Learning Approach for Accurate RMSD Estimation

Abstract: Root Mean Square Deviation (RMSD) prediction of tertiary protein structure is very important for structural biology, drug design, and protein engineering. Conventional models, however, cannot ensure high accuracy due to the inherent complexity of protein flexibility and stability. In this study, RMSD prediction is enhanced by combining Machine Learning (ML) and Explainable Artificial Intelligence (XAI) through the innovation of a novel Compactness Factor and the logarithmic transformation. These modifications are aimed at improving model performance by capturing structural properties more effectively. In predictive power evaluation, we apply a number of ML models, including Random Forest Regression (RFR), K Nearest Neighbors Regression (KNNR), Bootstrap Aggregating regression (BAGGINGR), CatBoost Regression (CBR), Decision Tree Regression (DTR), Extra Trees Regression (ETR), and Extreme Gradient Boosting Regression (XGBR). Among these, ETR is the best performing with R^2 of 0.713, adjusted R^2 of 0.712, Mean Squared Error (MSE) of 10.80, Root Mean Squared Error (RMSE) of 3.28, and Mean Absolute Error (MAE) of 2.17, which is an improvement over current research. Interpretability of the model is also enhanced using Shapley Additive Explanations (SHAP) and Local Interpretable Model-agnostic Explanations (LIME), which provide the contribution of significant features towards predictions. The results indicate that a combination of feature engineering, ML models, and XAI techniques improves RMSD prediction, pushing computational protein research and biomedical applications forward.

Abstractive Text Summarization for Bangla Language Using NLP and Machine Learning Approaches

Abstract: Text summarization involves reducing extensive documents to short sentences that encapsulate the essential ideas. The goal is to create a brief summary that effectively conveys the main points of the original text. We spend a significant amount of time each day reading the newspaper to stay informed about current events both domestically and internationally. While reading newspapers enriches our knowledge, we sometimes come across unnecessary content that isn't particularly relevant to our lives. In this paper, we introduce a neural network model designed to summarize Bangla text into concise and straightforward paragraphs, aiming for greater stability and efficiency.