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Classifying collisions in road accidents using XGBOOST, CATBOOST and SALP SWARM based optimization algorithms

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Abstract

Traffic accidents are the leading cause of death and injury in many developed nations. Anyone utilizing the road can meet an accident at any moment of time. The type of collision also plays a role in determining who is accountable for the accident. The biggest advantage of classifying collisions in road accidents can pave a way for safer roads and reduced accident rates. A novel approach is proposed for classifying the type of collisions that might take place between vehicles and near by pedestrians, obstacles etc. on roads. A total of six hybrid classifiers are introduced in this article namely "$XGBoost\ classifier\ using\ ISSA$", "$XGBoost\ classifier\ using\ ESSA$", "$XGBoost\ classifier\ using\ TVBSSA$", "$CatBoost\ classifier\ using\ ISSA$", "$CatBoost\ classifier\ using\ ESSA$", and "$CatBoost\ classifier\ using\ TVBSSA$", The dataset considered in this article is the SWITRS dataset for classifying "$Type\_of\_Collision$". A total of 103000 accidents are considered when determining the "$Type\_of\_Collision$". It classifies the type of collisions using XGBoost algorithm, CatBoost Algorithm and three Nature Inspired Algorithms (NIA's) have been used at the feature selection stage. The NIA's considered for feature selection includes Improved Salp Swarm Algorithm (ISSA), Enhanced Salp Swarm Algorithm (ESSA), and Time-Varying Binary Salp Swarm Algorithm (TVBSSA). It is concluded that $XGBoost\ classifier\ using\ ISSA$ presents good stability with fewer hyper-parameters and the highest accuracy under different levels of training data volume. The value of Accuracy, Mean Square Error, and ROC-Auc in XGBoost using ISSA is 90.40, 0.1624 and 97.75, respectively. Moreover, the confusion matrix and evaluation metrics of $XGBoost\ classifier\ using\ ISSA$ performed better than the other two approaches. The findings of this study would be helpful in classifying the "type of collision". These findings are highly significant in smart city projects to effectively establish timely proactive strategies and improve road traffic safety.

Keywords Type of collision · Nature inspired algorithm · Improved salp swarm algorithm · Enhanced salp swarm algorithm · Time-varying binary salp swarm algorithm

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