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Mortality Prediction of Victims in Road Traffic Accidents (RTAs) in India using Opposite Population SGO-DE based Prediction Model

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Getting immediate and appropriate care for the victims of Road Traffic Accidents (RTAs) in countries like India with huge population is a challenging job. In this paper a new hybridized evolutionary algorithm has been proposed for hyper-parameter tuning of the hyper-parameters of the prediction models using which mortality prediction of victims of RTAs in India have been performed. The proposed methodology Opp-SGO-DE has been used for parameter tuning in prediction algorithms like Random Forest (RF) and Support Vector Machine (SVM) and promising results were found from the experimentation. In RF, accuracy was increased from 0.75 to 0.82 and F1-score was increased from 0.66 to 0.77 in dataset-1 and accuracy was increased from 0.66 to 0.75 and F1-score was increased from 0.62 to 0.65 in dataset-2. In SVM, accuracy was increased from 0.63 to 0.74 and F1-score was increased from 0.58 to 0.67 in dataset-1 and accuracy was increased from 0.56 to 0.62 and F1-score was increased from 0.54 to 0.575 in dataset-2.

Keywords: Opp-SGO-DE, Parameter Tuning, Random Forest, Support Vector Machine

Introduction

Road Traffic Accidents (RTAs) are listed as one of the major concerns in public health issues worldwide. The global status report on road safety 2018 by the World Health Organization[1] reported the RTA as the eighth leading cause of deaths globally and thus several policies and laws have been formulated and reformed time to time for safety of individuals while driving as a precautionary measure to RTAs. Undoubtedly this is essential but the necessity of the standardized measures needed to be taken, after happening of a RTA, cannot be overlooked because from the analysis it was found that most of the deaths were preventable if patient would have received proper treatment on time. In developing and over populated countries like India, providing proper medical facilities to all the masses is a big challenge. In case of RTAs, diagnosis happen after the victim is taken to the hospital and many a times, victim has to shift to other hospitals due to lack of certain advanced medical facilities. So, in case of fatal injuries, many victims lose their life in between this transition time from the accident spot to hospital or moving in between the hospitals. There are no significant provisions for providing immediate medical attention to the fatal patients and it is obvious too, as doctors cannot be there with each ambulance. The deaths caused in RTAs is more in cities than the rural areas as cities have more traffic but the problem faced in rural areas is the non-availability of immediate medical facility as hospitals are not nearby. Thus irrespective of the locations, availing adequate and immediate treatment to the victims of RTAs is a major challenge. With high population growth rates, increasing mobility, and growing numbers of vehicles, tremendous change has occurred to the road transportation network in India over the years and hence significant rate of growth in deaths due to RTAs could be observed. Technical intervention in this field is definitely a major demand in this time.

Many researchers have worked on finding potential solution to this problem. Boo & Choi[2] in their paper showed a comparative study of four prediction models (Logistic Regression, Random Forest, Linear SVM and RBF-SVM) for mortality determination in RTAs. Similarly, Alharbi *et al.*[3] reviewed various factors for predicting mortality in traumatic injured patients of RTAs. Samad *et al.*[4] proposed a technique to predict injury severity score in relation to morbidity and mortality in RTAs. Kenneth *et al.*[5] statistically analyzed regression techniques for modelling of RTAs in Nigeria. Similarly, Vipin & Rahul[6] analyzed mortality in RTAs based on time of occurrence in Kerala.

From the literature it can be witnessed that prediction models play a major role in analyzing and

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Table 2 — Performance analysis of Opp-SGO-DE based RF and SVM

Dataset	Random Forest				Support Vector Machine			
	Accuracy		F1-Score		Accuracy		F1-Score	
	RF	RF-Opp-SGO-DE	RF	RF-Opp-SGO-DE	SVM	SVM-Opp-SGO-DE	SVM	SVM-Opp-SGO-DE
Dataset-1	0.75	0.82	0.66	0.77	0.63	0.74	0.58	0.67
Dataset-2	0.66	0.75	0.62	0.65	0.56	0.62	0.54	0.575

Fig. 6 — (a) Comparison between Accuracy and F1-Score values of RF and RF with Opp-SGO-DE for dataset-1; (b) Comparison between Accuracy and F1-Score values of SVM and SVM with Opp-SGO-DE for dataset-1

Fig. 7 — (a) Comparison between Accuracy and F1-Score values of RF and RF with Opp-SGO-DE for dataset-2; (b) Comparison between Accuracy and F1-Score values of SVM and SVM with Opp-SGO-DE for dataset-2

analysis of RF and SVM on both the datasets, which is given in Table 2, clearly shows that the proposed Opp-SGO-DE yielded better results and would perform similarly if used with other algorithms too.

Conclusions

The proposed Opp-SGO-DE algorithm provided promising results when applied for hyper-parameter tuning of prediction algorithms such as RF and SVM. A significant increase in Accuracy and F1-score value could clearly be observed from the experiments performed. Number of fitness evaluations have been reduced to half in the proposed algorithm than the original SGO for which significant decrease in time complexity was observed. One limitation of the proposed methodology is increase in algorithmic parameter. In original SGO, only one algorithmic parameter i.e. 'c' or self-instrospection parameter was there, but in proposed methodology two algorithmic parameters i.e. 'C_r' or Crossover rate and 'M_r' or Mutation rate, were introduced but that does not add much to the algorithm's complexity and hence is

acceptable. In the literature no work on mortality prediction or analysis using SVM or RF could be found on the used datasets, thus more such works could be carried out and mortality prediction analysis could be performed. This is an emerging domain and could help in development of automated systems for emergency medicines. These type of works, if implemented practically could significantly help developing countries like India where death rate due to RTA is so high.

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