Original Article

Automotive Vehicles Quality Prediction based on Features Customization and Differentiators using Artificial Neural Network in Comparison with Digraph Approach

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Abstract

Aim: The aim of the proposed work is to predict the performance of an Artificial Neural Network (ANN) algorithm in detection of vehicle quality performance based on Features customization and differentiators by comparing it with the Digraph algorithm. **Materials and Methods:**The proposed ANN is trained and tested with a "Novel Car Evaluation Database" created by Marko Bohanec. With correct quality 826 samples and inaccurate quality 826 samples in two groups with a total sample size of 1652. Training data [75% of dataset] and testing data set [25% of data set] are separated from the obtained samples. The samples are calculated using G power analysis using clincalc, which includes two groups: alpha (0.05), power (80%). There is a statistically significant difference between the groups with p=0.04 **Results:** The proposed ANN algorithm provided better results in predicting the quality of novel car evaluation compared to the Digraph approach. **Conclusion:** For the given data set, from the results it is found that the ANN algorithm is significantly more suitable for recognition of better car quality.

Keywords: Novel Car Evaluation, ANN, Digraph, Features customization, Prediction, Quality

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INTRODUCTION

Cars are a fundamental component of our way of life. Different producers create diverse sorts of cars within the car commerce. Clients have an assortment of choices when it comes to car determination. Clients will generally base their choices on cost, security, consolation, and how extravagant the vehicle takes after (Zhang and Zhang 2011). These components are more pivotal in decreasing mischances. The main application of car quality assessment is that clients and makers both benefit from a solid assessment technique (Castro et al. 2020). It soothes businesses of their burden and boosts deals. In a profoundly competitive advertisement, it too gives prevalent benefit levels for clients (Castro et al. 2020; Jain and Kr 2017).

Numerous analysts have distributed in IEEE xplore around 37 investigate articles, around 729 inquire about articles in Google Researcher and around 153 investigate articles were distributed in science coordinate. An investigation conducted by (Szczęsna et al. 2016) on the car assessment dataset utilises different information mining strategies to explore the quality execution of different classifiers. (Castro et al. 2020; Jain and Kr 2017; Kuehbeck et al. 2014), In this work, different sorts of information mining classification strategies to the car assessment dataset are connected (Edgar 2020). The strategy made with the preparing dataset has been assessed with the standard measurements such as precision, review and accuracy. In investigation conducted by (Pudlo et al. 2006), client input and extricate curiously designs from the dataset and execute clusters. (Eleanor and Abraham 2014) proposed a strategy to assist producers in arranging to make strides in the quality of car items. (Han, Pei, and Kamber 2011) Within the past few a long time, the classic information mining models.such as calculated relapse, manufactured neural systems and Back Vector Machine have been effectively executed in numerous areas to illuminate common issues in deals, investigation and generation. By displaying (Groh et al. 2019) individually utilising Irregular woodland, fake neural organisation, bolster vector machine these models anticipating their exactness, review and accuracy were compared. It appears that the Irregular timberland calculation has got the most excellent appraisal and novel car quality prediction.

Our institution is passionate about high quality evidence based research and has excelled in various fields (Parakh et al. 2020; Pham et al. 2021; Perumal, Antony, and Muthuramalingam 2021; Sathiyamoorthi et al. 2021; Devarajan et al. 2021; Dhanraj and Rajeshkumar 2021; Uganya, Radhika, and Vijayaraj 2021; Tesfaye Jule et al. 2021; Nandhini, Ezhilarasan, and Rajeshkumar 2020; Kamath et al. 2020). The disadvantages of the existing system is that the accuracy in predicting the quality of car is low. To address this the proposed ANN algorithm performs novel car evaluation for prediction analysis based on features customization and differentiators.

Materials And Methods

The proposed work is done at Computer Vision Lab in the Department of Computer Science and Engineering, Saveetha School of Engineering, SIMATS. Two diverse datasets are considered for foreseeing the execution of calculations, which are accessible in the UCI store (Eleanor and Abraham 2014). Amid preprocessing, categorical information is changed over to numerical values, and invalid values are expelled from the dataset. The entire test estimate is1239 samples and six attributes. Least control of the investigation is settled as 0.8 and most extreme acknowledged blunder is settled as 0.2 (Horn and Putnam 2012; Wu, Bi, and Sai 2020).

The proposed algorithm is developed in PYTHON programming language at the GOOGLE COLAB cloud platform (Uma Shankar et al. 2017). The examinations are carried out on a computor with an Intel core i3 processor having 4GB of RAM.

Artificial Neural Network (ANN)

Artificial Neural Networks (ANNs) is an artificial intelligence tool, which is utilised to perform data analysis. The main objective of ANN is to produce a predictive model which is effective in time and accurate. ANN is a sequence of neurons and synaptic pathways which occurs between them. Every neuron will get the set of information which is reflected by a value of a quantity of various variables and in that one variable will be the output. MLP consists of input, hidden and output layers. Most predictive models based on MLP networks utilise this type of ANN to predict the car quality. The following are the steps in assessing the car quality: Select the technical parameters having great impact on the vehicle quality prediction.

1. Develop a database of learning ability
2. Calculate the correlation and coefficients with respect to the input variables.
3. Perform the sensitivity analysis and features customization using differentiators
4. Perform comparison and evaluation based on acceptability of the predictive models on the basis of the values of the post prediction error measures.

Digraph Approach

A digraph represents the variables and their dependencies as nodes and edges. Edges with direction indicated are named as directed graphs and without directional edges are undirected graphs. For example, the effect of a change in variable x on variable y might be more powerful than the effect of a change in variable u on variable v. We might want to estimate the strength of this effect, rather than merely the sign. We shall speak of a weight w(x, y), a positive or negative real number placed on the arc (x, y), and corresponding to the strength of the effect.

A digraph with two weights on each arc, one representing strength of effect and one representing time lag, is called a double-weighted digraph. In this paper, we limit ourselves to double-weighted digraphs. In truth, the mathematical problems in analysing even double-weighted digraphs are quite difficult, and we shall be able to analyse the double-weighted digraphs constructed in this paper in detail only by approximating them by weighted digraphs without time lags. In this case the approximation seems to be quite appropriate, but it may not always be so.

Statistical Analysis

The statistical analysis of the proposed version is performed using SPSS (McCormick and Salcedo 2017a). For the dataset taken into consideration, the independent variables are the input variables specifically buying, maint, doorways, folks, lug-boot, safety, magnificence. Dependent variables are structured functions particularly accuracy, consideration and precision.

Results

Table 1 shows the different datasets with sample size and features. Car evaluation dataset contains 1652 samples, 6 features with 4 classes. Car dataset contains 1239 samples, 6 features with 4 classes. Table 2 represents the

statistically extracted features from the dataset. The statistical features extracted are count of samples, mean, standard deviation, minimum and maximum values. Table 3 shows the statistical analysis of 10 samples, The ANN has obtained accuracy of 86.12 and Digraph model obtained 78.66% accuracy. Table 4 performs Independent t-test was used to compare the accuracy of two algorithms and a statistically significant difference was noticed 0.04 ($P<0.05$). Figure 1 shows the comparison of ANN algorithm and Digraph algorithm in terms of mean accuracy. The mean accuracy of the ANN algorithm is better than the Digraph approach. In X axis ANN and Digraph algorithm (groups) and Y Axis Mean accuracy of detection ± 1 SD.

Discussion

In this study, overall performance of ANN and Digraph approach is analysed in classifying novel vehicle overall performance from the dataset acquired from UCI repository. From the results it is observed that the accuracy of the ANN appears to be higher than the digraph approach.

The similar findings of the approach tackles the troubles in both datasets by upgrading exactness for the ANN calculation which performs better (Groh et al. 2019; Kuehbeck et al. 2014). Exact evaluation of the advancement of car worthiness has gotten to be an imperative theme. The datasets considered in this article, the ANN algorithm are able to detect the performance of cars with moderate accuracy (McCormick and Salcedo 2017b) This study observed that, in ANN algorithm by changing the number of nearest neighbours (k values) accuracy of car quality decreases 82.3%. (Sun et al. 2021). The proposed and existing works differ by number of attributes, samples and amount of data and implemented deep learning neural networks with an accuracy of 85.2%. Opposite findings by (Kavitha 2019) proposed a random forest classifier for classification purposes and achieved an accuracy of 96% which is better than ANN.

The drawback of the proposed ANN algorithm is that it does not perform well on large and noisy datasets. In future this can be improved by utilising the hybrid algorithms.

Conclusion

Evaluation of accurate car quality prediction decreases accidents. By comparing the performance of both the algorithms the proposed algorithm overcomes the problems of existing algorithms. ANN algorithm shows better results than the Digraph approach in terms of accuracy.

DECLARATIONS

Conflicts of interests

No conflicts of interest in this manuscript.

Author Contributions

Author KAK was involved in data collection, data analysis and manuscript writing. Author SMK was involved in conceptualization, data validation, and critical review of the manuscript.

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Tables and Figures

Table 1. Different datasets with sample size and features. Novel Car evaluation dataset contains 1652 samples, 6 features with 4 classes. Car dataset contains 1239 samples, 6 features with 4 classes.

Datasets	No. of samples	Features	Classes
car evaluation	1652	6	4
car dataset	1239	6	4

Table 2. Comparing ANN and Digraph algorithms. Accuracy values obtained for ANN and Digraph algorithms are compared for different iterations.

Accuracy		
S.no	**ANN**	**Digraph**
1	83.40	76.80
2	84.10	77.00
3	84.70	77.40
4	85.10	77.80
5	86.05	78.10
6	86.70	78.50
7	87.10	79.10
8	87.60	79.50
9	88.05	81.20
10	88.37	81.20

Table 3. ANN and Digraph algorithms statistical analysis. Mean accuracy value, Standard deviation and Standard Error. Mean for ANN and Digraph algorithms are obtained for 10 iterations.

	Groups	**N**	**Mean**	**Std.Deviation**	**Std.error Mean**
Accuracy	DIGRAPH	10	78.6400	1.55292	.49108
	ANN	10	86.1170	1.72611	.54584

Table 4. Independent sample test for significance and standard error determination. P value is less than 0.05 considered to be statistically significant and 95% confidence intervals were calculated.

Leven's Test For Equality of Variance				**t-test for Equality of Variance**					**95% Confidence Interval of the difference**	
Accuracy		**F**	**sig.**	**t**	**dif**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**lower**	**upper**
	Equal Variance	.223	0.04	10.05	18	.000	7.45	.742	5.89	9.015

	assumed									
	Equal variance not assumed			10.05	17.87	.000	7.45	.742	5.89	9.016

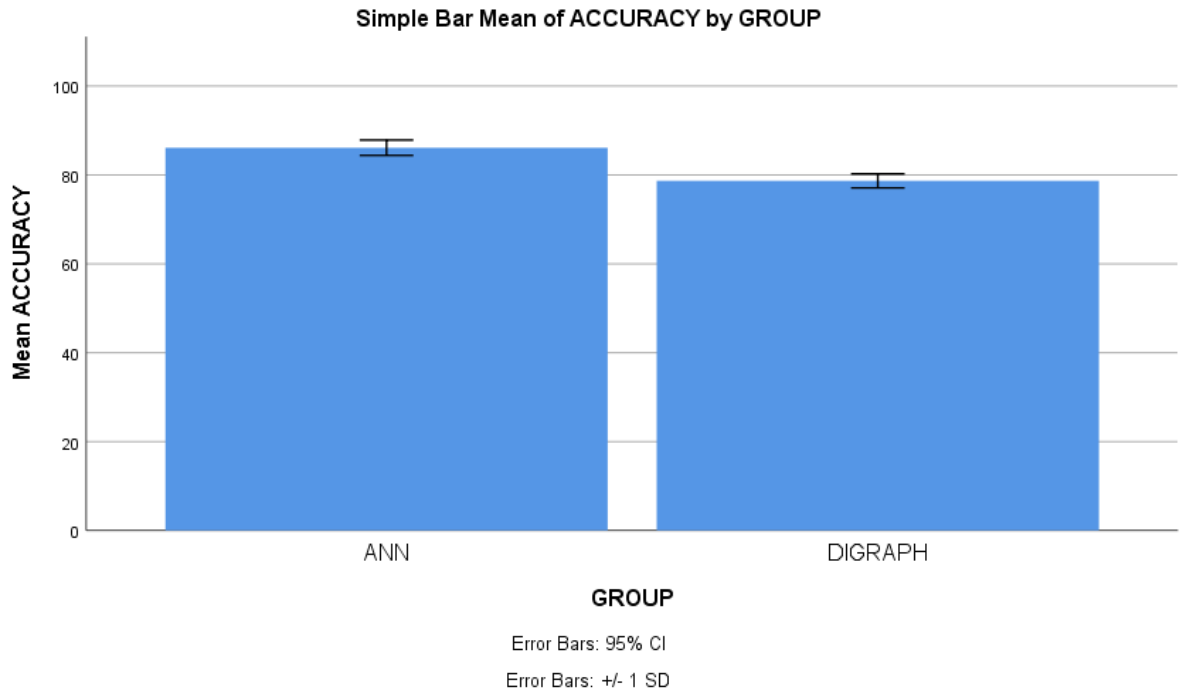

Fig. 1. Comparison of ANN algorithm and Digraph algorithm in terms of mean accuracy.The mean accuracy of the ANN algorithm is better than the Digraph approach. In X axis ANN and Digraph algorithm (groups) and Y Axis Mean accuracy of detection ± 1 SD.