[1]Ting Chen
[2]Bing Duan*

Intelligent Analysis of E-commerce Reviews based on Complex-Valued Spatio-temporal Graph Convolutional Neural Network Optimized Tyrannosaurus Optimization Algorithm

JES Journal of Electrical Systems

Abstract: - Intelligent analysis of E-commerce reviews based on multimodal social media big data using applies the benefit of innovative artificial intelligence method, especially deep learning algorithms, to study and realize web-based product consider and social network data connected to e-commerce. In this manuscript, Intelligent Analysis of E-commerce reviews based on Complex-Valued Spatio-temporal Graph Convolutional Neural Network Optimized Tyrannosaurus Optimization Algorithm (IAER-CVSGCNN-TOA)is proposed for Intelligent Analysis of E-commerce Reviews. The input data are collected from E-commerce big Dataset. Then data are pre-processing utilizing federated neural collaborative filtering (FNCF) to remove the noise and clean the data. The pre-processed data is provided to the CVSGCNN is used for intelligent analysis of e-commerce reviews. In general, CVSGCNN does no express adapting optimization approaches to determine optimal parameters to ensure accurate prediction. Hence, proposed to utilize the Tyrannosaurus Optimization Algorithm enhancement CVSGCNN for intelligent analysis of e-commerce reviews. The proposed IAER-CVSGCNN-TOA method is implemented on python. Then performance of proposed technique is analyzed with other existing techniques. The proposed technique attains 30.26%, 28.70% and 46.25% higher accuracy, 20.53%, 32.60%, and 53.43% higher precision, 25.23%, 23.15%, and 22.33%higher recall, 25.75%, 44.30% and 53.70%higher specificity comparing with the existing methods such as a Retracted: Online Troll Reviewer Detection Utilizing Deep Learning Methods (IAER-CNN), Developing an Intelligent System and DL Algorithms for Sentiment Analysis of E-Commerce Product Reviews(IAER-LSTM), Intelligent Perception System of Big Data Decision in Cross-Border e-Commerce Depend on Data Fusion(IAER-DFN) respectively.

Keywords: CVSGCNN, C Intelligent analysis of e-commerce, federated neural collaborative filtering, Tyrannosaurus Optimization Algorithm.

I. INTRODUCTION

As previously mentioned, antisocial activity on social media platforms is only possible to identify if suspicious intelligent analysis of e-commerce is found [1]. Intelligent analysis of e-commerce collects and analyzes input and behavior from clients, involving complaints, delayed delivery, and exchanges [2]. Antisocial behavior on internet with intelligent analysis, other e-commerce bring harm to web users, even potentially undermine democracy in few countries [3]. In order to identify patterns in multiple social networks, this study suggests developing algorithms using methods based on deep learning [4]. It should be possible to determine the approach that is better for developing this detection model-sentiment research or deep learning and better for analyzing various kinds of text data, data gathered from structure of web-based evidence by looking at the comparison's outcomes [5,6]. In current years, development of IT with internet-depend application for ensued in individuals to each across the world are producing huge amounts of data [7].New content is created for various kinds of internet-based platforms, such as applications, social media status updates, and movies or images on websites for e-commerce [8]. Social media, e-commerce websites, mobile platforms, applications, other kinds of media, enable people to share data, platform their ideas, perspectives on goods, services and other social problems [9]. Reviews of products online are making a greater influence on consumer purchasing choices [10]. The strengths, weaknesses of company's goods, services by customer feedback is effective method in construction enterprises, permitting business owners to capture what customers want, attain them by better options [11]. Feedback from consumers on the benefits and drawbacks of the goods and services offered by an organization is a useful tool for entrepreneurs looking for ways to increase their client base [12]. It allows them to recognize patterns in the market and present consumers the best choices [13].

[1] Yibin Vocational & Technical College, Yibin Sichuan 644100, China
[2] Department of Finance and Commerce, Qinghai Higher Vocational and Technology College, Haidong, Qinghai, 810799, China
*Corresponding Author Email: duanbing1205@outlook.com
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Analyzing and evaluating customer product reviews continues into a competitive advantage for organizations in a variety of fields, especially e-commerce [14]. Consumer can distribute the information and takes a decision and discerning on goods and services, and internet-based problems, mobile platforms, e-commerce websites, applications, and other information [15]. Reviews of products on the internet are getting more and more common and have an increasing effect on consumers' purchase decisions. Particularly given they enable it possible to control internet discussions while being totally private [16]. A person's entire profile needs to be carefully examined [17]. Websites are developing artificial intelligence to detect and prevent comments that look deceptive [18].

The issue is mainly serious because the e-commerce actively spread hoaxes, misinformation. Primary objective of this research is to make framework that accurately identify intelligent analysis and work together with various web sites that are presently attempting to prevent scammers. Comparing various methods of ML, sentiment analysis to identify most effective technique for developing discovery methods for exact circumstances is an essential aspect of this research.

Major contributions of this proposed method are abridged below:

- The Intelligent Analysis of E-commerce reviews based on CVSGCNN Optimized Tyrannosaurus Optimization Algorithm is proposed.
- The input data are collected from E-commerce big Dataset. The data are pre-processing utilizing federated neural collaborative filtering (FNCF) to remove the noise and clean the data.
- Intelligent analysis of e-commerce has done by using CVSGCNN and is optimized with Tyrannosaurus Optimization Algorithm for Intelligent analysis of e-commerce.
- The performance metrics likes accuracy, precision, recall, specificity, F1-score,RoC are examined.
- The proposed technique is analyzed with existing IAER-CNN, IAER-LSTM and IAER-DFN methods.

The remaining manuscript organized as below: part 2 presents literature review, part 3 designates proposed method, part 4 shows outcomes, part 5 conclusion.

II. LITERATURE REVIEW

Several research studies were presented in literature linked to deep learning depend intelligent analysis of e-commerce, a few recent works are reviewed here,

In 2022, Al-Adhaileh, et.al, [19] have presented Online Troll Reviewer Detection Utilizing DL Methods. Here, emphasis was on identifying clowns among consumers and reviewers in discussion groups and link-sharing on social media aggregators like Wikipedia. We focused our efforts on social media users, considered a particular category of suspicious reviewers. The method that e-commerce reviewer uses deep learning and sentiment analysis to determine the general mood of its troll comments sets them different from other consumers. It provides higher accuracy, lower specificity.

In 2022, Alzahrani, M.E., et.al, [20] have presented emerging intelligent system with DL methods for sentiment analysis of E-commerce product reviews. Here, sentiment analysis of assessments infield of e-commerce, DL-CNN integrated by LSTM models were used. Real-time data, including reviews of cameras, smart phones, computers, tablets, TVs, video surveillance systems from Amazon website, was utilized to test, evaluate the system. It provides high precision and high accuracy.

In 2021, Zhang, X., et.al, [21] have presented intelligent perception scheme of big data decision in cross-border e-commerce depend on data fusion. Here, focused on developing the data-fusion-based the large data decision intelligent perception system. It is comparable to the process of innovation involved in improving the way that data fusion is applied to e-commerce business method. The big data determination intellectual detecting network framework design experimentation, quaternion method, data fusion process, data fusion network method were its primary components. It provides high specificity and low RoC.

In 2022, Li, J., et.al, [22] have presented E-Commerce Fraud Detection Method by Computer AI-DM. Here, uses cloud computing-based big data processing methods and concentrates on the implementation of e-commerce intelligent recommendation process through evaluation technique for a recommendation scheme in big data environment. It provides high F1 Score and low RoC.

In 2021, Yu, R., et.al, [23] have presented analysis of impact of big data on e-commerce in cloud computing environment. Here, uses Using Map Reduce, the data mining technique can be parallelized, and a Hadoop-based commodity recommendation system may be developed with this knowledge. We developed a feature-rich e-commerce shopping centers system using Java EE technology. This study analyzes the effects of cloud

computing, mobile e-commerce, core the internet, and e-commerce applications. That can be used to achieve e-commerce precision marketing, and implement security measures to reduce transaction risk. It provides high precision and low recall.

In 2022, Li, Y., et.al, [24] have presented Research on Intelligent Recommendation Model of E-Commerce Commodity Depend on Feature Selection with Deep Belief Network. Here, described the way in which consumers, businesses, e-commerce sites, and systems for recommendation the correlation concept between consumer demand and product recommendation was built through a study of the internal connection between both of them. Using an analysis of the features of the consumers' desire for the items, the method of data mining was employed to categorize. It provides high recall and low F1 score.

In 2022, Liu, L., et.al, [25] have presented e-commerce personalized recommendation depend on ML technology. Here, examines the e-commerce industry's personalized the recommendation technology. It does this by thoroughly examining the relevant technologies and algorithms and by suggesting the most recent architecture for the system based on its current state of development. The algorithm separates into two components: offline mining as well as online recommendation. It then evaluates and applies the features and technologies of each section, recommending accuracy and real-time needs. It provides low Roc and low F1 score.

III. PROPOSED METHODOLOGY

The Intelligent Analysis of E-commerce Reviews based on CVSGCNN Optimized Tyrannosaurus Optimization Algorithm is depicted. Block diagram of IAER-CVSGCNN-TOA intelligent analysis of e-commerce reviews is shown in figure 1. It contains four stages like data acquisition, preprocessing, intelligent analysis of e-commerce and optimization. Thus, the detailed description IAE-CVSGCNN-TOA about is given below in figure1,

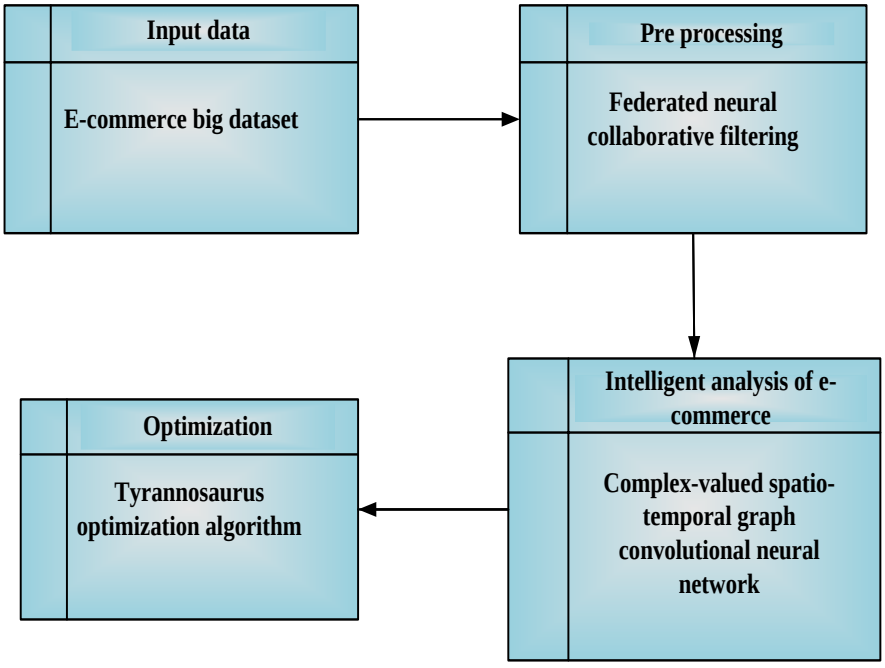

Figure 1: Block diagram for IAE-CVSGCNN-TOA method for intelligent analysis of e-commerce reviews

A. Data Acquisition

Input image is collect from E-commerce big dataset [26].A collection of data obtained from multiple online businesses across multiple product categories is referred to as an E- Commerce big dataset from a multi-category. This dataset contains over 60,000 data points and includes information such as product names, prices, descriptions, categories, and user reviews.

B. Pre-processing using Federated Neural Collaborative Filtering

In this step, data pre-processing using Federated Neural Collaborative Filtering [26] is discussed. Federated neural Collaborative Filtering method makes it feasible to train models without revealing local data, sending raw client updates presents further privacy concerns. In order to solve this specific problem, researchers employ a secure collection technique that satisfies safety requirements for an honest but inquiring organization. The

federated neural collaborative filtering removes the noise and cleans the data. To calculating the standard predictive distribution is given in equation (1),

$$W_{v+1} \leftarrow \sum_{i=1}^{|c|} \frac{m_i}{m} W_{v+1}^{i} \tag{1}$$

Where, $|c|$ represents number of input data, m_i denotes number of reduces the data, $\sum_{i-1}^{|c|}$ signifies total number of redundancy of data and W_{v+1}^{i} relevant information produced by the involved entity i. To remove the duplicates of the data is given in equation (2),

$$WI_{v+1}^{i} + I_{v+1}^{i} + \sum_{i \in c: i<j} IS_{ij} - \sum_{i \in c: i>j} IS_{ji} \tag{2}$$

Where, IS_{ij} represents then number of selected data, $i \& j$ is an ordered pair of participant, WI_{v+1}^{i} computed weights with masks and $\sum_{i \in c: i<j}$ it can be denotes the remove of the duplicate data. To variation of the frequency is given in equation (3),

$$I_{v+1} = \frac{WI_{v+1}^{sum}}{|c|} \tag{3}$$

Where, $|c|$ denotes number of selected participants at time t, WI_{v+1}^{sum} is the initialized the relevant information. Finally, the data removes the noise and clean the data by using Federated Neural Collaborative Filtering. The pre-processed data is given to feature extraction phase.

C. Intelligent Analysis E-commerce using Complex-Valued Spatio-temporal Graph Convolutional Neural Network

In this section, classification using CVSGCNN is discussed [27]. Every operation involves a direct relationship with the graph shift operator, including filtering, transformation, and forecasting. The trainable parameter in a graph-convolutional neural network is its coefficients. It has been emphasized how complicated and real GSP differ significantly from one another. The shift variant function is given in equation (4),

$$m = H(S)y \tag{4}$$

Where, $H(S)$ represents the shift variant function, m is the rectifying invalid function, y is the frequency function. To calculate the shift variation function is given in equation (5),

$$H(S) = \sum_{K=0}^{K-1} h_k S^k \tag{5}$$

Where, k can be infinite, S^k is the shift variant function, h_k is the linear function and $\sum_{k-0}^{k-1}$ is the equal and reduces the variation function. Scalar product to the time variant function is given in equation (6),

$$m = H(S)y \Leftrightarrow \overline{m} = \overline{h} \,\Theta\, \overline{y} \tag{6}$$

Where, $\overline{y}$ vector product, $\overline{h}$ bar is the measure the constant value m is calculate the total value of the data, Θ is the scalar product between the two vectors. Then the calculate the time variant function is in given equation (7),

$$Y(z) = \sum_{t=0}^{K_{t-1}} y_t z^{-t} \tag{7}$$

Where, $Y(z)$ is the integer of a data, $\sum_{t-0}^{K_{t-1}}$ is the equal and reduces the time variant function, $y_t z^{-t}$ is the frequency and redundancy of time. Modules vector function is given in equation (8),

$$M(z) = H(S \otimes z)Y(z) \tag{8}$$

Where, $M(z)$ denotes the disjoint function of a two element, $Y(z)$ is the integer of a data, $S \otimes z$ is the tensor product of vector in two elements. Graph temporal transfer function is given in equation (9),

$$H(S \otimes z) = \sum_{K=0}^{K-1} H_k(z) S^k \tag{9}$$

Where, $H(S \otimes z)$ represents the tensor product of shift variant function, $H_k(z)$ is the hyper parameter. The random static solution is given in equation (10),

$$\overline{m} = \sigma \sum_{k=0}^{K-1} h_k S^k x \tag{10}$$

Where, $\overline{m}$ represents the random static, S^k is the shift variant function, h_k is the linear function. Finally, CVSGCNN intelligent analysis of e-commerce has been done. Because of its convenience, pertinence, the machine learning based optimization strategy is taken into the CVSGCNN classifier. The TOA is employed to optimize the CSAGAN. The TOA is employed for tuning weight, bias parameter of CVSGCNN**.** Then pre-processed image is given to feature extraction phase.

D. Optimization using Tyrannosaurus Optimization Algorithm (TOA)

The weight parameter $\overline{y}\ and\ h_k$ of CVSGCNN is optimized using the TOA [28] is discussed. The TOA's most recognized advantages are its speed at identifying the best possible solutions. It can significantly increase the effectiveness of e-commerce big dataset analysis, facilitating faster decision-making and enhanced company procedures. As the TOA is resistant to noise and data disruptions, it can deal with partial or incorrect datasets, which are frequent in e-commerce. Improved evaluations and forecasts are made feasible as an outcome, increasing decision-making. These dinosaurs once populated North America over sixty-six million years ago; the T-Rex, in particular, resided there. The regalest of the various dinosaurs is the tyrannosaurus.

1) Stepwise Procedure of TOA

Here, step by step procedure is defined to get ideal value of CVSGCNN based on TOA. Initially, TOA makes the equally distributing populace to optimize the parameter of CVSGCNN. The best solution is promoted using TOA algorithm and related flowchart is illustrated in Figure 2.

Step 1: Initialization

A population-depend process that determines amount of prey at search area, randomly initialized as given in equation (11),

$$Y_i = s\,and\,(np, \dim) * (ub - lb) + lb \tag{11}$$

Where, np denotes number of populations, $\dim$ signifies dimension of search space, ub denotes upper limit, lb signifies lower limit.

Step 2: Random generation

Input parameters produced at randomly. Ideal fitness values were chosen depend on obvious hyper parameter condition.

Step 3: Fitness function estimation

A random solution is created using initialized evaluations. Using parameter optimization value, fitness function is evaluated for optimizing weight parameter $\overline{y}\ and\ h_k$ of the intelligent analysis of e-commerce. This is given in the below equation (12),

$$Fitness\ function = optimizing \overline{y}\ \&\ h_k \tag{12}$$

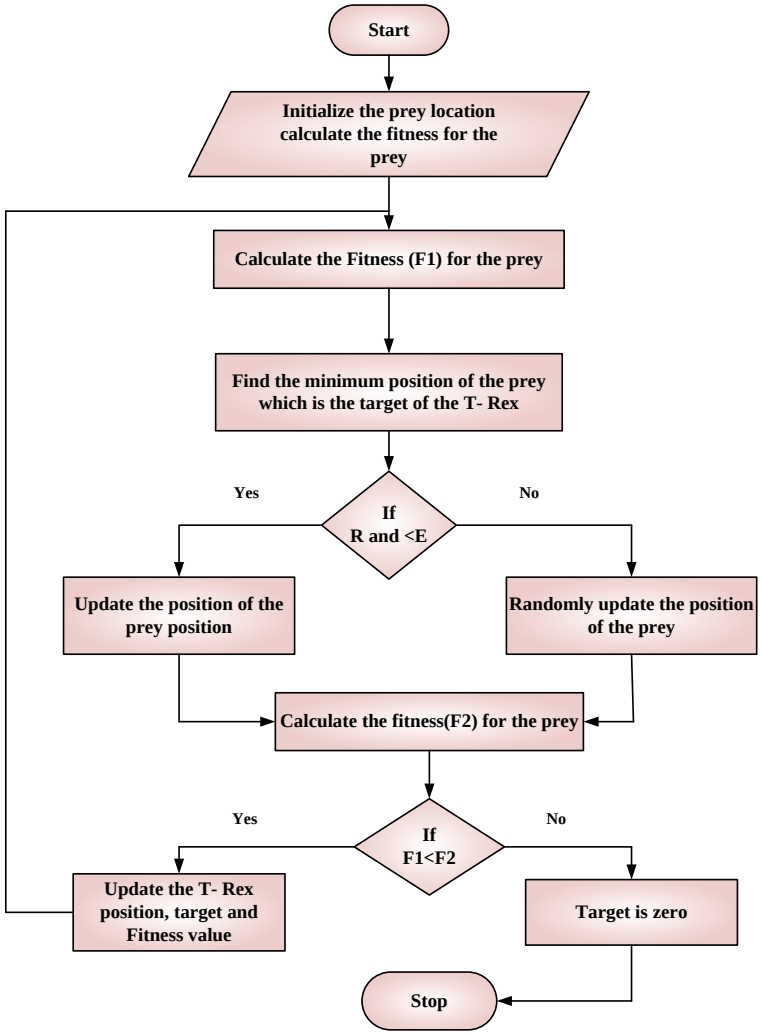

Fig2: Flowchart of TOA for optimizing CVSGCNN parameter

Step 4: Exploration

Similar to a wolf, lion, or another apex predatory animal, a T-Rex hunts its prey. T-Rex efforts to hunt when spots its neighboring prey. It can sometimes fight itself against attackers or try escape. Children are involved in search for recovery of prey, consequently when the T-Rex pursues, it does it at random. It is given in equation (13 & 14)

$$Y_{new} = \begin{cases} y_{new} & if\ r\ and(\ ) < Er \\ Random & else \end{cases} \tag{13}$$

Where, Er represents the estimated time of arrival at the dispersed prey,

$$y_{new} = y + r\ and(\ ) * sr * (tpos * tr - t\arg et * pr) \tag{14}$$

Where, sr denotes success rate of hunting, tr is the running rate of T- Rex, pr signifies prey running rate.

Step 5: Exploitation phase for optimizing $\bar{y}$ & h_k

The prey's location- that is, its prior and recent locations-determines the method of choosing. In the event that the prey escapes or defends itself against hunting, prey location becomes zero and T-Rex is unable to hunt. By evaluating fitness with function, it is realized.

$$Y_i^{k+1} = \begin{cases} update the t\arg et\ position & if \quad f(Y) < f(Y_{new}) \\ t\arg et\ is\ zero & otherwise \end{cases} \tag{15}$$

Where, $f(Y)$ denotes fitness function for initial randomly prey position, $f(Y_{new})$ is the fitness function for updated prey location.

Step 6: Termination Condition

With the aid of TOA, the weight parameter value $\bar{y}$ & h_k from CVSGCNN are optimized using TOA, iteratively repeat step 3 until fulfill halting conditions $Y = Y + 1$.Then, the IAER-CVSGCNN-TOA method effectively access the intelligent analysis of e-commerce with high accuracy and low computational time.

IV. RESULT WITH DISCUSSION

In this part, the experimental outcomes of the indicated procedures are discussed. The proposed IAER-CVSGCNN-TOA method is applied by using python. The obtained outcome of proposed is analyzed with existing techniques likes IAE-CNN, IAE-LSTM, IAE-DFN respectively

A. Performance measures

Performance metric like accuracy, specificity, precision, recall, F1-score and RoC are examined for performance measures. To measure performance metrics, performance matrix is considered. The following matrixes are required to scale the performance metrics.

- TN: Presents count of values which are appropriately predicted as negative.
- TP: Presents count of positive values which are appropriately recognized as positive.
- FP: Presents count of positive values which are inappropriately recognized as positive.
- FN: Presents count of values which are inappropriately recognized as negative.

1) Accuracy

It is ratio of number of exact synthesis with total predictions made for a dataset. It is measured through the equation (16),

$$Accuracy = \frac{(TP + TN)}{(TP + FP + TN + FN)} \tag{16}$$

2) Precision

Precision is a metric which quantifies the count of correct positive prediction made. It is calculated using equation (17),

$$precision = \frac{TP}{(TP + FP)} \tag{17}$$

3) Recall

It is a metrics that computes predictions made by correct number of positive predictions made by total positive predictions. It is calculated using equation (18),

$$\mathrm{Re}call = \frac{TP}{TP + TN} \tag{18}$$

4) Specificity

The percentage of true negatives that the method correctly identifies is called specificity. It is given in equation (19),

$$Specificity = \frac{TN}{TN + FP} \tag{19}$$

5) F1-Score

F1-scorecombines precision, recall into a single value, providing a balance between these two important metrics. It is computed in equation (20),

$$F1Score = \frac{TP}{\left(TP + \frac{1}{2}\left[FP + FN\right]\right)} \tag{20}$$

6) RoC

An integrated measurement of a measurably effect or phenomena is the RoC. It is scaled by equation (21),

$$RoC = 0.5 \times \frac{TN}{FP + TN} + \frac{TP}{FN + TP} \tag{21}$$

B. Performance Analysis

Figure 3 to 10 portrays stimulation outcomes of IAER-CVSGCNN-TOA proposed method. Then, the proposed IAER-CVSGCNN-TOA technique is analyzed with existing methods likes IAER-CNN, IAER-LSTM, and IAER-DFN respectively.

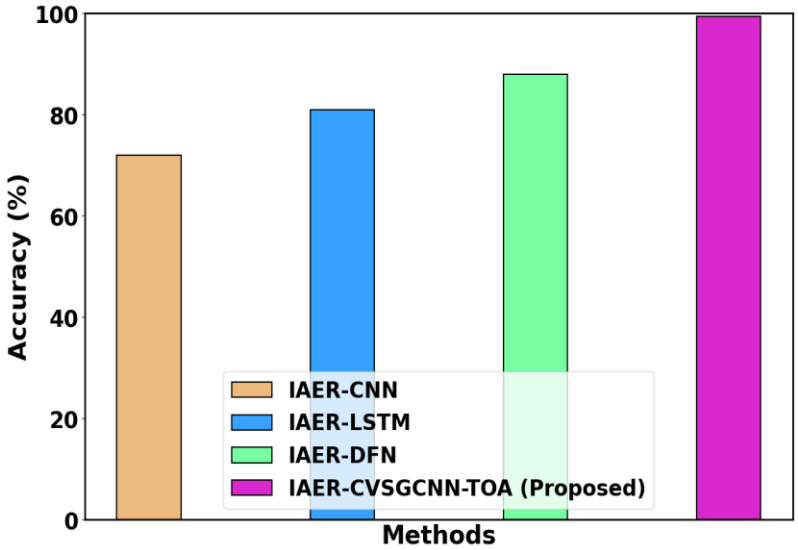

Figure 3: Accuracy analysis

Figure 3 shows accuracy analysis. Here, IAER-CVSGCNN-TOA attains 26.36%, 20.69% and 30.29% higher accuracy analyzed with existing IAER-CNN, IAER-LSTM, and IAER-DFN respectively.

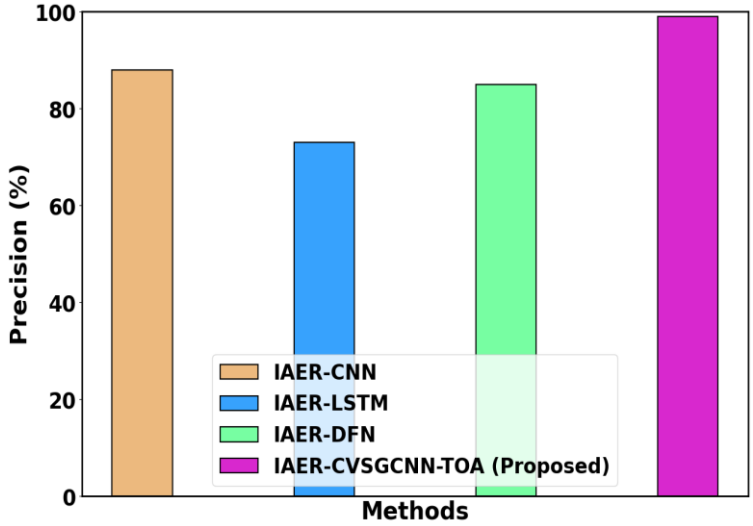

Figure 4: Precision analysis

Figure 4 shows precision analysis. Here, IAER-CVSGCNN-TOA attains 19.23%, 22.56%, and 30.96% higher precision when analyzed with existing methods such as IAER-CNN, IAER-LSTM, and IAER-DFN respectively.

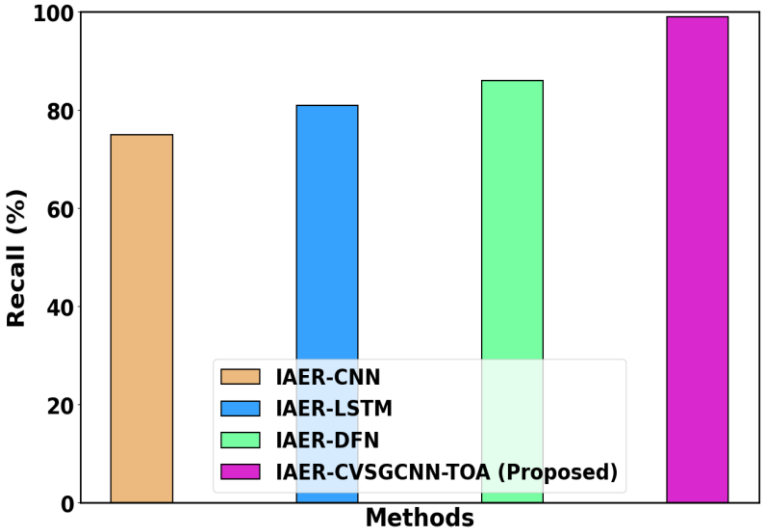

Figure 5: Recall analysis

Figure 5 shows recall analysis. Here, IAER-CVSGCNN-TOA attains 10.43%, 12.56%, and 23.56% higher recall when analyzed with existing methods such as IAER-CNN, IAER-LSTM, and IAER-DFN respectively.

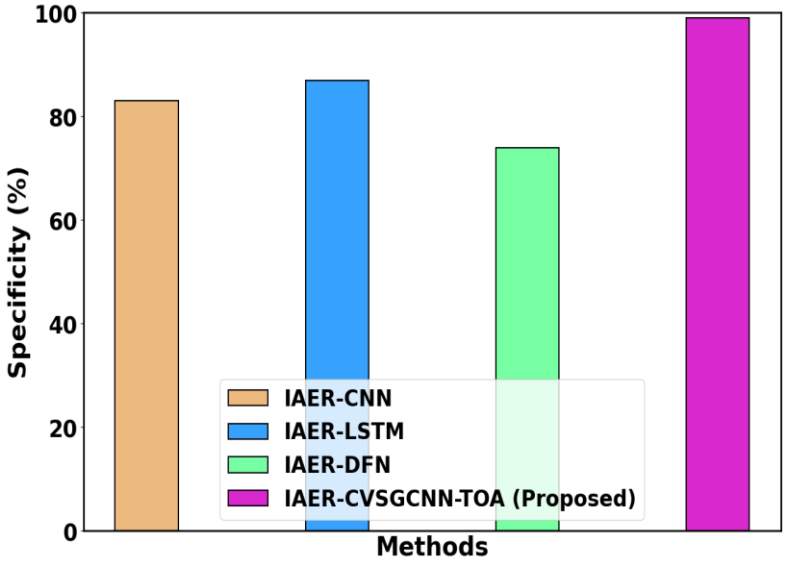

Figure 6: Specificity analysis

Figure 6 shows specificity analysis. Here, IAER-CVSGCNN-TOA attains 15.93%, 22.6%, and 28.76% higher specificity when analyzed with existing methods such as IAER-CNN, IAER-LSTM, and IAER-DFN respectively.

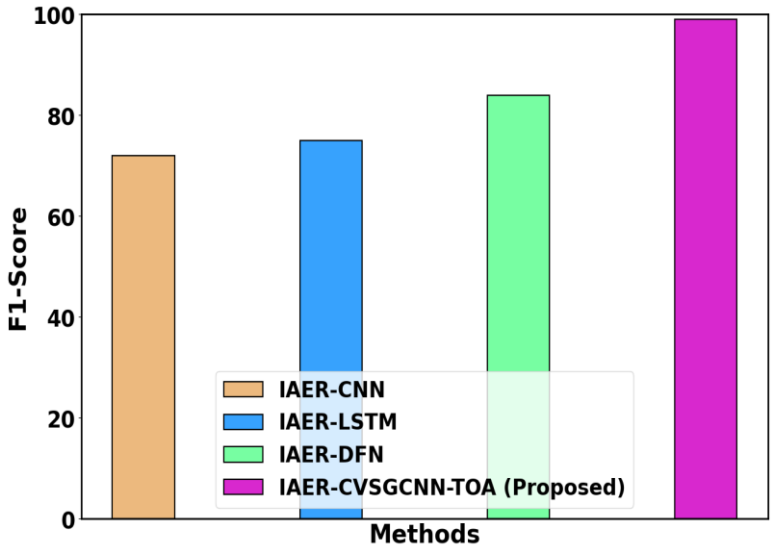

Figure 7: F1- score analysis

Figure 7 shows F1-score analysis. Here, IAER-CVSGCNN-TOA attains 20.37%, 19.68%, and 28.56% higher F1-Score when analyzed with existing methods such as IAER-CNN, IAER-LSTM, and IAER-DFN respectively.

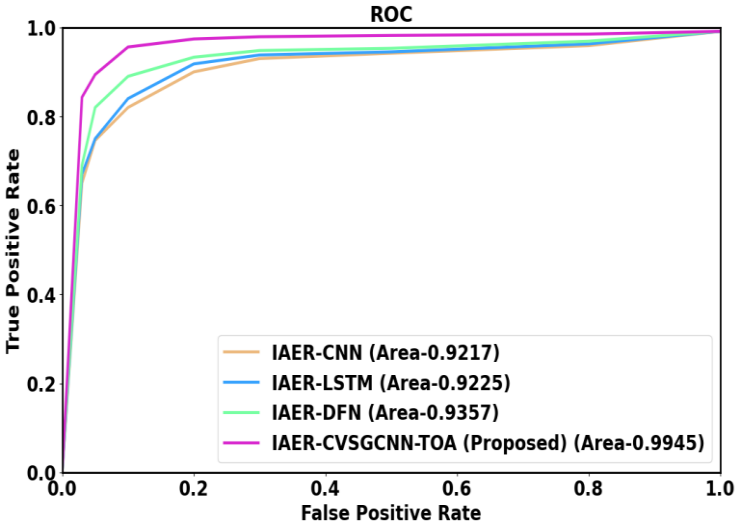

Figure 8: RoC analysis

Figure 8 shows RoC analysis. Here, IAER-CVSGCNN-TOA attains 19.37%, 29.48%, and 19.56% higher F1-Score when analyzed with existing methods such as IAER-CNN, IAER-LSTM, and IAER-DFN respectively.

C. Discussion

In this work, IAER-CVSGCNN-TOA model for the intelligent analysis of e- commerce is discussed. The assessment of sentiment, which involves classifying the feelings that are expressed in reviews, is one aspect of this analysis. A more accurate knowledge of consumer opinion can be obtained established by taking account of both textual and visual clues, such as the emotions portrayed in written words or the emotional expressions on customers' faces in photographs or video, e-commerce platforms can use such data to recognize favorable and unfavorable evaluations, as well as learn the real reasons of each and modify their operations properly. The empirical evaluation of proposed IAER-CVSGCNN-TOA method is highlighted through a range of evaluation metrics likes accuracy, specificity, Recall, precision, F1-score, RoC. Presenting a comparison of the accuracy achieved the proposed technique to that of IAER-CNN, IAER-LSTM, and IAER-DFN. It concludes that the proposed IAER-CVSGCNN-TOA method is better than existing models for intelligent analysis of e- commerce.

V. CONCLUSION

In this manuscript, Intelligent Analysis of E-commerce Reviews based on CVSGCNN Optimized Tyrannosaurus Optimization Algorithm is successfully implemented. Generally, the intelligent analysis of e-commerce reviews allows trade about useful insights enabling to make the data driven decisions improve consumer experiences and secure a outfoxing in the market. The performance of IAER-CVSGCNN-TOA method approach contains 29.46%, 20.34%, and 25.27% greater F1-score, 45.18%, 13.65% and 40.25% greater RoC when analyzed with existing methods such as IAER-CNN, IAER-LSTM, and IAER-DFN respectively. In the future the progress deep learning can possible for improving the outcomes.

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