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Socio Political News Detection Using Enhanced Graph Neural Network

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ABSTRACT

Purpose: In the age of data driven by social media, the proliferation of socio-political news has amplified the challenges of detecting misinformation, biases, and polarized news. Socio-political news detection process is essential for promoting knowledgeable decision-making among citizens, assessing public sentiment, influencing policy formulation, tracking crises, strengthening international relations, and maintaining public security.

Design/Methodology/Approach: This paper introduces a hybrid model for detection of socio-political news by merging BERT model (Bidirectional Encoder Representations from Transformers) with Graph Neural Networks (GNN). The proposed model leverages the ability of BERT's contextual embedding to capture semantic information form text and incorporates it with the structural insights of Graph Neural Networks to model the relational dependencies among news elements, such as headlines, article and entities. RSS feeds are collected to estimate the proposed model's performance.

Findings: It demonstrated superior performance in terms of accuracy, precision and recall compared to traditional machine learning methods and independent deep learning models.

Originality/Value: The proposed socio-political news detection approach offers a robust solution by incorporating various models. It provides researchers to manage and perform analytical task of socio-political news.

Paper Type: View Point

KEYWORDS: Graph Neural Network | Contextual Embedding | RSS Feeds | Political News

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Introduction

Socio-political news (Earle and Hodson, 2022) encompasses information that indicates both social and political dimensions of culture. It contains updates on a myriad of political events, social issues and government policies, as well as their impacts on individuals and communities. This category of news often highlights subjects such as votes, judicial reforms, social justice movements, worldwide relations and civil rights. However, with the extensive use of online media by youth, there has been a surge in miscellaneous news content. Identifying and detecting this data is essential for understanding the topics that engage netizens; although it can be complex. Accurate and efficient classification methods enable the analysis of public view on the cyberspace in real time, but they require sophisticated techniques. Consequently, numerous NLP (Natural Language Processing) techniques have become vital to recent research work to analyze and categorize publicly available news corpus content, because online news facilitate a more nuanced understanding towards public sentiment. (Alkaabi, 2024) With the rise of social network platform and digital era, the socio-political new have becoming easily accessible and pervasive day by day. This socio-political news may disclose the interrelation between social and political parties focusing on trending discussions such as civil rights, economic inequality, policies related to pollution and political ideologies. By highlighting these issues, socio-political news influences public discourse and shapes collective opinions on pressing matters. It plays a pivotal role in shaping public opinion, influencing policy decisions and driving societal discourse However, the swift dissemination of news across various online platforms has introduced challenges such as misinformation, biased reporting and agenda driven narratives. These challenges not only endanger the credibility of social media, but also carry profound implications for democracy, governance and public trust.

The detection of socio-political news (Hürriyeto□lu et al. 2023) has emerged as a crucial area of research aimed at tackling these issues that covers issues at the intersection of societal and political domains. Recent advancements in NLP a deep learning technique present new opportunity for addressing these issues. By leveraging advanced computational techniques, researchers endeavor to identify and analyze socio-political news to ensure its authenticity, detect biases and comprehend its impact on society. Context-aware embedding models like BERT, distilBERT and graph-based techniques such as Graph Neural Networks (GNNs) and graph attention network (GAT) have demonstrated potential in capturing both semantic and relational data. These techniques enable researches to construct robust systems that not only classify news content, but also comprehend the underlying relationships and trends within socio-political narratives. Although the integration of machine learning, natural language processing (NLP) and graph-based approaches has shown promising results, it remains a complex task because of the intricate nature of socio-political content.

This paper presents a novel method for detecting socio-political news, utilizing an enhanced Graph Neural Network (GAT). By merging the semantic depth of BERT with the relational modeling strengths of GAT, the suggested framework tackles the complex connections among textual content, sources and relevant metadata. This approach aspires to deliver a more accurate and nuanced detection of socio-political news. However, it also confronts the challenges posed by misinformation (Kasim et al. 2021) and bias in the digital media landscape, which are increasingly prevalent because of the rapid spread of information. Although it is a significant advancement, the effectiveness of this framework will ultimately depend on its implementation in real-world scenarios. The contribution is as follows:

1. An enhanced graph Neural network model is proposed for the first time to detect socio-political news from online data.

2. The context rich word embedding is generated using pretrained BERT model to capture semantic statistics from textual data more precisely in accordance to the sentiment of the news articles.

3. The Graph Neural Network is utilized as a classification model to refine the extracted features and identify socio-political news more accurately.

4. To evaluate the performance of proposed BERT-GNN model, it is compared with the existing methods.

The remainder of the paper is organized in the following manner:

Literature review is covered in Section 2 for socio political news and socio-political news detection from text data. In section 3, the proposed model is explained with context rich work embedding generation using pre-trained BERT model and graph Neural network for detection of socio-political news. Experiments and outcomes are discussed in section 4 in detail. At the end, the paper concludes with a summary of findings and discusses potential directions for future work.

Related Work

The detection and classification of socio-political news has emerged as a significant domain of analysis, motivated by the growing necessity to scrutinize and evaluate news content within the framework of public discourse, misinformation and political narratives. Kontos et al. (2012) presented a socio-political narrative in English-Greek language news data. Early adapted methodologies in the detection of socio-political news although effective but mainly relied heavily on conventional machine learning models, including

Support Vector Machines (SVM), Decision Trees and Naive Bayes classifiers. However, while they proved effective with smaller datasets, these strategies were frequently constrained by their inability to adequately capture the semantic subtleties and contextual relationships inherent in the text. This limitation has prompted further research into more advanced techniques. Hürriyeto□lu et al. (2020) described the procedure of automated extraction of socio-political events from news articles. These techniques concentrated on text classification tasks, employing features such as term frequency-inverse document frequency (TF-IDF), bag-of-words (BoW) and n-grams to categorize news articles into socio-political classifications. As Munshi et al. (2014) explored the role of media in creation and legitimation of certain shadow public which then go on to influence public policies related to government or society. As in the current research shown, Chakraborty et al. (2016) proposed a novel methodology for real word events extraction and extract events related relevant information from large news dataset. Further, extracted events are used to predict variations in diverse socio-economic indicators. Socio political news may be affected by fake news on social media as de Medeiros et al. (2022) shown how fake news influence the socioeconomic/ political factors.

Recent studies have begun to explore deep learning models (2021), particularly Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), to detect socio-political news. These models can inevitably learn complex aspects and patterns from huge size of text data, providing improved classification performance. Socio-political news classification is performed by Büyüköz et al. (2020). Singh P. et al. (2024) proposed a BiLSTM based method using BERT model for socio-political news detection from RSS feeds of different sources. A key challenge, however, is the noisy and unstructured nature of openly available text data, which often includes inconsistent formats, duplicate content, and unreliable sources (Talaat, 2023). To address this, some studies (Kumar et al., 2023) have incorporated data preprocessing techniques such as stop-word removal, tokenization, and entity recognition to enhance the quality of input data (Veli□kovi□, 2023).

Topic classification of online news corpus is performed in Daud et al., (2023) using hyperparameter-optimized Support vector machine algorithm. It proposed a model to categorize the news according to their respective field such as political, entertainment, economy etc. Wang et al. (2024) provided a systematic review on text classification using graph neural network-based algorithms. It explored the advancements in text classification through graph neural networks (GNNs) up to the year 2023and also highlighted various state of art methods at both the corpus and document level text classification. This analysis provided a comprehensive comparison of existing techniques for text classification task and also offers to get insights into future directions on improvement of text classification using graph neural network models. However, the field is rapidly evolving and growing, this exploration remains crucial for understanding emerging trends using recent technologies.

The extensive availability of online news content poses a considerable challenge, as much of this information remains uncategorized which complicates analysis and interpretation for most of the research work. Although some researchers have tackled this problem in the past, the majority of their efforts have concentrated on identifying fake news (DeLucia et al., 2024) rather than on comprehensive classification of news content (Macis et al., 2024). Furthermore, most studies concerning news categorization depend heavily on benchmark datasets (Barrett et al., 2024); (Olsen et al., 2024) these datasets are frequently pre-organized, failing to capture the complexities of real-world scenarios. Models trained on such datasets lack generalizability and struggle to perform effectively when they are applied to unstructured and diverse online news data. Additionally, existing methods often overlook computational efficiency, resulting in the necessity for resource-intensive approaches that may not be practical for large-scale or real-time applications.

To address these research gaps, in existing models, this paper focuses on developing a novel framework for detecting socio-political news that incorporates BERT generated word embeddings with a graph neural network model. The integration of semantic and relational perceptions objectives to address the gaps of state of art methods and provide an extensive method for socio-political news detection from online news articles. It used pretrained BERT model to enhance the performance of graph neural network. As BERT model effectively capture the contextual information while generating the word embedding of input text data.

Proposed Methodology

Given the intricate landscape of social news articles within the context of political news, an effective method must be considered to precisely distinguish socio-political elements and extract the information associated with socio-political from news data. The block diagram for proposed model is shown in Figure 1 (b). It is divided into three main sections:

1. Text Preprocessing
2. Context-rich word embedding
3. Detection model

Text Preprocessing

The process of text preprocessing plays an essential step in the preparation of openly available text data such as twitter's tweet data, news articles and Facebook feeds to make the data clean and structured for further analysis. The steps for creation of structured news corpus is visualized in

Figure 1 (a). It guarantees that the data is clean and structured for computational processing. Online news frequently contains noisy and inconsistent elements (such as HTML tags, advertisements, URLs and special characters) that can significantly hinder the effectiveness of learning models. It commences with the cleaning of the text, which entails the removal of unwanted elements such as punctuation, stopwords and special characters. One of the preprocessing steps is Tokenization that subsequently applied to divide the text into tokens (e.g., words or phrases), thereby facilitating further analysis in text data. Lemmatization is employed to reduce words to their base forms, for example 'better' is being reduced to its base form as 'good'. Thus, it ensures the consistency across the various iterations of the same word and also maintain the frequency according to the occurrence.

Additionally, named entity recognition (NER) and part-of-speech (POS) tagging are utilized to extract meaningful entities and grammatical structures from the text. Through the implementation of these preprocessing steps, the raw textual data derived from online news articles can be converted into a standardized format. This transformation enables effective analysis and model training. However, it is crucial to ensure the integrity of the data. It enhances the overall quality of the analysis. This is essential for achieving reliable outcomes in any subsequent research.

Context-rich word embedding

After the conversion of raw news corpus to structured news corpus using preprocessing, the next step is to generate the context rich word embedding with the help of pretrained BERT model. BERT is a state-of-the-art model in the field of NLP that is widely utilized for the purpose to generate work embedding due to its capability to produce context-rich word embeddings. Unlike traditional static word embedding methods for example GloVe, or Word2Vec which generate static embeddings, BERT captures the contextual meaning of words based on their surrounding text. This bidirectional understanding enables BERT to disambiguate words with multiple meanings and incorporate subtle nuances of text. By transforming preprocessed text into dense, high-dimensional vectors, BERT embeddings provide a robust foundation for further detection. This ensures that the model processed the words themselves and comprehend their relationships and implications within the socio-political narratives they convey.

Detection Model

The detection model is performed using graph neural network to detect socio-political news from online news corpus.

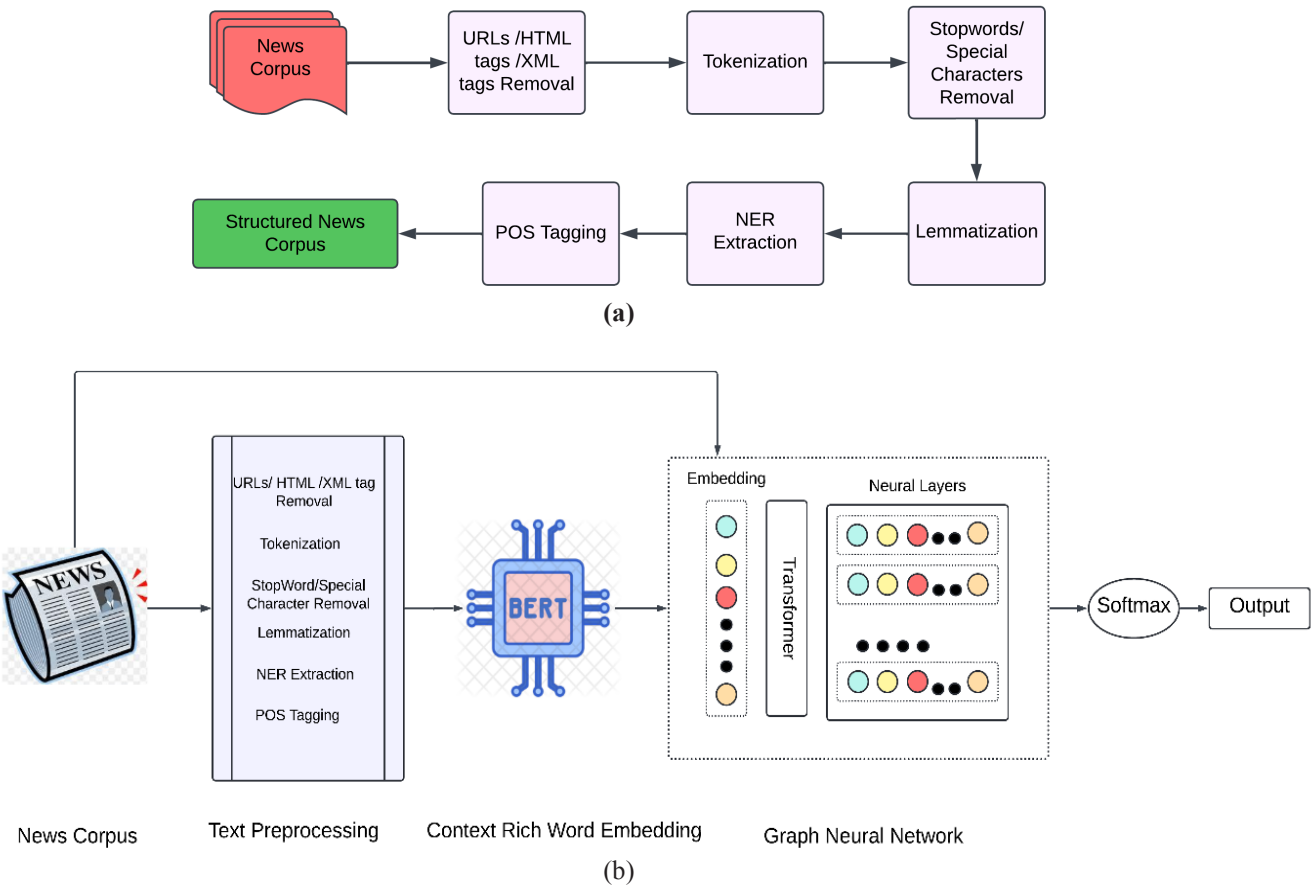

Figure 1: (a) Steps for creation of structured news data; (b) Block diagram of proposed model

GNNs performs well in such area, however, they can adeptly model the intricate relationships that exist among entities, topics and sources typically found in socio-political news. This process commences with the formation of a graph representation of the dataset, where nodes signify news articles, keywords, and entities for instance, political keywords and events, whereas edges encapsulate the relationships among them, such as co-occurrence, citation and similarity.

After the construction of graph, context rich word embedding generated by BERT for each news article is assigned as feature vectors to each node that enrich the graph with contextual semantic information. Then, attention mechanism is used to assign weights to neighbors of a node based on their relevance to the previous news. Linear transformation is represented as feature vectors of each node. Attention Coefficients is calculated for each pair of connected nodes (i, j) in the constructed graph. It highlighted the requirement of a node to a source node in the representation. The coefficients are derived from a widely used attention mechanism, which generally consists of a single layer of a feedforward neural network applied to a LeakyReLU activation function, as demonstrated in Eq. (1).

$$e_{ij} = LeakyReLU\left(a^T\left[Wh_i \parallel Wh_j\right]\right) \quad \text{.....(1)}$$

The aggregation of features from neighboring nodes occurs through the utilization of normalized attention coefficients, which serve as weights in the graph. This process results in a weighted summation of the neighbor features; subsequently, these are integrated with the features of the node itself to yield an updated representation, as illustrated in Eq. (2).

$$h'_i = \sigma \sum_{j=n_i} \alpha_{ij} Wh_j \quad \text{.....(2)}$$

In this context, σ denotes a non-linear activation function, such as ReLU, which is employed to infuse non-linearity into the model.

Ultimately, the softmax function is applied to produce the scores that signify the importance or relevance pertaining to their contextual representation. Nodes that achieve a higher attention score are deemed more pertinent or relevant within this framework. However, this method hinges on the proper computation of attention coefficients to ensure effective feature aggregation. The last layer generated logits for every node in relation to node classification tasks. However, this process involves complex computations and the layer's output is critical, it is not the sole determinant of performance. Because of this, proper interpretation of the logits is essential for effective classification as in Eq. (3).

$$Z = softmax(h'_i) \quad \text{.....(3)}$$

Where, $h'_i\, h'_i$ represents node embedding from the last layer of graph neural network and Z represents the output of the proposed BERT-GNN model.

Experiments and Results

In this section, experimentation and results are enlightened in detail for proposed BERT-GNN model. A step wise explanation for proposed model's experiments and results is illustrated including dataset collection, model implementation and training setup, model evaluation metrics, and comparative analysis with existing methods for socio-political news detection from text data. Initially, the collection of datasets is deliberated thoroughly.

Dataset

The dataset utilized for this study was meticulously curated by aggregating online news articles from publicly accessible RSS (Really Simple Syndication) feeds. RSS feeds are extensively employed by news websites and publishers to disseminate real-time updates in a structured XML format. It offers a rich and continuous stream of news articles addressing a variety of topics, including socio-political content.

The collection process involved subscribing to multiple RSS feeds from reputable news sources such as the Hindu, Hindustan times and times of India are considered in collecting the RSS feeds for socio political news detection. Each RSS feed encompasses metadata—such as the title, description, publication date and a link to the full article. The metadata fetched along with the news articles are sometimes valuable for identifying, detecting, and categorizing socio-political news content; however, it generally presents challenges in terms of data management. A web scraping tool using python library was utilized to regularly retrieve the latest updates on news websites, which ensured that the dataset captured dynamic, real-world news trends. However, the collected raw news articles were then filtered to eliminate duplicates and irrelevant articles. Each news article was linked to its corresponding metadata, thereby it may provide better semantic information.

Model Implementation and training setup

The initiation of the proposed model's implementation started with the embedding generation process, whereby node feature vectors were produced using context-rich word embeddings derived from BERT. The word embedding provides a robust semantic foundation and captures the contextual significance of words and sentences found within socio-political news articles. Subsequently, a Graph neural

network was employed to process the constructed graph; this network utilized an attention mechanism to weigh the relationships between nodes, effectively identifying the most pertinent connections within the graph structure. The model training was carried out with the Adam optimizer to facilitate efficient convergence. Hyperparameters of graph neural network such as the learning rate, the number of layers in the network and the number of attention heads were meticulously fine-tuned to attain optimal performance.

Model Evaluation

In the model experiment section, several methods are utilized to propose the socio-political news detection model and their performance is compared to the baseline methods. The baseline methods employed in this work are LSTM with word2vec, BiLSTM with word2vwc and LSTM with BERT. They were selected to serve as a comparison for the proposed BERT-GNN model due to the fact that they represent progressively advanced techniques. However, it is important to note that some variations may exist. Although the focus is on comparison, the nuances of each approach will be highlighted. This analysis is crucial because it provides insight into the effectiveness of different strategies. The evaluation metrics—Accuracy, Precision, Recall and F-score—were employed to assess the model's performance.

The results of proposed model and baseline methods are presented in the table 1 that demonstrates the efficacy of existing methods; including the proposed BERT-GNN, in detecting socio-political news from raw news corpus. The combination of Word2Vec embeddings with an LSTM network performs a bit low across all the confusion metrics. Word2Vec is used to generate static embeddings that may not be able to capture the context-dependent meaning of words in socio-political news data.

Utilizing a BiLSTM on the top of word2Vec enhanced the BiLSTM framework by integrating bidirectional sequential information, this improved combination makes model to capture and the sequential patterns more precisely from news text. The word2vec with BiLSTM model is performed with accuracy: 84.7%, precision: 85.6%, recall: 85.0% and f-score is 85.3%. However, the static embeddings provided by the Word2Vec still constrain the detection model's ability to discern nuanced socio-political related contextual information because of contextual shifts often arise. Although this method has its advantages, it remains limited in certain aspects. The comparison graph for proposed model is visualized in the Figure 2.

Table 1 Performance comparison of the proposed method with the baseline methods

Methods	Accuracy (%)	Precision	Recall	F-Measure
LSTM with word2vec	67.2	67.2	78.4	72.37
Bi-LSTM with word2vec	84.7	85.6	85	85.3
LSTM with BERT	92.3	94	91.2	92.58
Proposed BERT-GNN	**94.8**	**93.9**	**95.3**	**94.59**

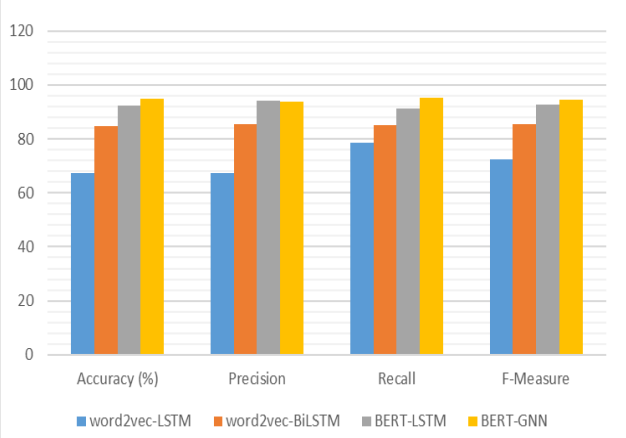

***Figure 2:** Performance comparison of the proposed model to baseline methods*

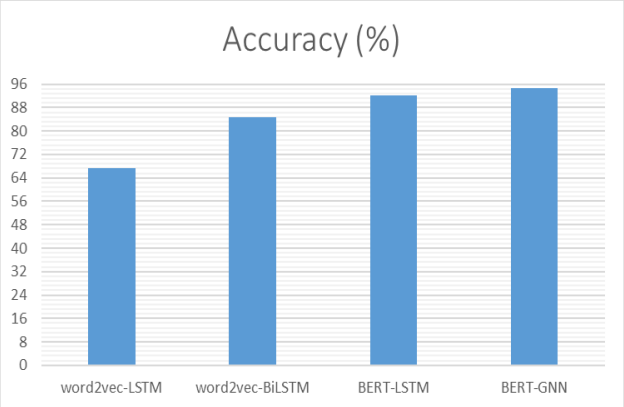

Figure 3: Accuracy of proposed model in comparison of state of art methods.

The proposed BERT-GNN model achieves the highest performance across all metrics, thus demonstrating its performance in term of accuracy and efficiency. The proposed model performs with accuracy of 94.8%; precision of 93.9%; recall of 95.3% and f-score of 94.59%. Pretrained BERT models generated context rich embeddings that offers a robust semantic solution because it able to capture contextual information from text data more precisely, while the GNN adeptly model's relationships and dependencies inherent in the news data (for instance, the co-occurrence of entities and shared themes).However, the GNN's capacity to leverage the graph structure facilitates a more comprehensive understanding of the socio-political context, resulting in improved generalization and enhanced accuracy. Although the model performs well, there are aspects that could be further refined.

BERT-GNN enhances accuracy by 2.5% in comparison to BERT-LSTM and by 10.1% relative to Word2Vec-BiLSTM. This indicates the efficacy of incorporating relational information through GNN, in addition to semantic embeddings. The proposed model achieves a balanced precision and recall, highlighting its ability to accurately identify pertinent socio-political news, while minimizing false positives and negatives. This balance is crucial for real-world applications where both precision and recall are important. Unlike the baseline models, BERT-GNN excels at capturing both the semantic context using BERT and the relational structure through GNN, which results in a 9.29% enhancement in F-Measure over Word2Vec-BiLSTM. Figure 3 illustrates the accuracy of proposed model and state of art methods. These results underscore the importance of merging context-aware embeddings with relational learning, showcasing the robustness and practical utility of the proposed BERT-GNN model for the detection of socio-political news from publicly available text dataset. The integration of contextual semantics and relational information allowed the proposed model to grasp nuanced socio-political narratives and the interdependencies between entities. This makes it a robust solution for applications that necessitate accurate categorization of complex news data such as misinformation detection, public sentiment analysis and socio-political trend monitoring. However, this showcases the importance of the proposed method when contrasted with baseline approaches. Although the results are promising, further refinement may be necessary because the field is continuously evolving. It offers a thorough analysis, demonstrating how the proposed BERT-GNN model excels beyond both traditional and modern approaches. It underlines its strengths in merging semantic understanding with relational insights, particularly for socio-political news classification.

Conclusion

This study introduced a novel framework for the detection of socio-political news, utilizing a BERT-enhanced Graph Neural Network (BERT-GNN). The model effectively merges context-rich word embeddings produced by BERT with the relational learning strengths of a graph neural network It addresses the challenges posed by semantic ambiguity and relational complexity found in socio-political news articles. Experimental results indicated that the BERT-GNN model surpassed baseline methods, achieving the accuracy of 94.8% and demonstrating significant enhancements in precision, recall and F-measure metrics.

Future work

Although the proposed BERT-GNN model outperforms state-of-the-art method's performance, several possibilities are remained for future exploration. Transitioning from static to dynamic graph representations can enable the model to adapt to evolving socio-political trends over time. Incorporating multimodal data such as images, videos and metadata alongside textual information could further enhance the model's understanding of socio-political news content; this would be significant because it adds depth to the analysis. Additionally, extending the framework to support cross-lingual and multilingual news analysis will broaden its applicability to global socio-political contexts. Finally, deploying the model in real-world systems for automated news monitoring will allow evaluation under practical conditions, including challenges like misinformation and adversarial scenarios; this presents an opportunity for meaningful improvement.

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Annexure 16.3.8

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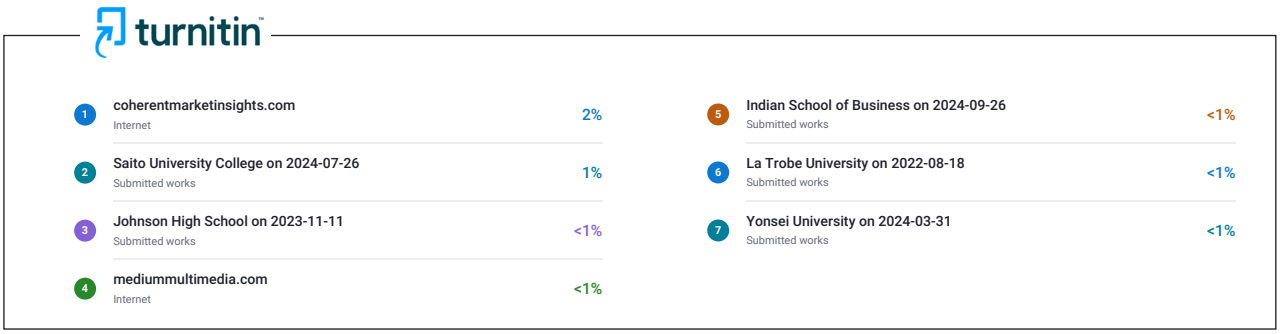

Reviewers Memorandum

Reviewer's Comment 1: This study presents an innovative approach that integrates BERT with Graph Neural Networks (GNN) for the identification of socio-political news. A more clear explanation of the interaction among these models and their contributions to the overall classification would be worthwhile. Besides, a comparison with different hybrid models or an ablation study could improve the rationale for the chosen structure.

Reviewer's Comment 2: The integration of RSS feeds for model evaluation is a fascinating concept; nonetheless, the research might benefit from the inclusion of explanations regarding the reliability and diversity of the sources. The model's robustness may be enhanced through talks of dataset bias, data preparation practices, and the influence of misinformation in the training data. Moreover, a more transparent study of performance metrics, such the F1-score and confusion matrix, would provide additional insight into the model's efficacy.

Reviewer's Comment 3: The study is a valuable contribution to socio-political news detection; at present, its practical implementation and scalability require additional scrutiny. Considering possible challenges such as adversarial manipulation of news content, ethical considerations in automated detection, and constraints in real-world implementation will enhance the paper's effect. Additionally, suggesting possible enhancements, such as multilingual adaption or real-time analytical capabilities, may provide avenues for future study.

Citation

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Editorial Excerpt

The article has 08% of plagiarism which is the accepted percentage as per the norms and standards of the journal for publication. As per the editorial board's observations and blind reviewers' remarks the paper had some minor revisions which were communicated on a timely basis to the authors (Pratima Singh & Amita Jain), and accordingly, all the corrections had been incorporated as and when directed and required to do so. The study proposes a novel method for identifying socio-political news by combining BERT's contextual embeddings with Graph Neural Networks' structural learning capabilities. The model shows superior accuracy, precision, and recall compared to current methods. However, further data specifics, acknowledging biases in training data, and exploring practical application and implementation issues could improve the study's validity. The language is clear and accessible, making it suitable for both academic and practitioner audiences. Overall, the paper contributes valuable insights into the future of education. After comprehensive reviews and the editorial board's remarks, the manuscript has been categorized and decided to publish under the "**View Point**" category.

Acknowledgement

The acknowledgment section is an essential part of all academic research papers. It provides appropriate recognition to all contributors for their hard work and effort taken while writing a paper. The data presented and analyzed in this paper by authors (Pratima Singh & Amita Jain) were collected first handily and wherever it has been taken the proper acknowledgment and endorsement depicts. The authors are highly indebted to others who facilitated accomplishing the research. Last but not least, endorse all reviewers and editors of GJEIS in publishing in the present issue.

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