



SENTIMENT ANALYSIS AND HYBRID TWO-TIER META-LEARNING CLASSIFICATION FOR COVID-19 RUMOR TWEET DISCOVERY: A SURVEY

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Abstract

In the age of social media, information moves quickly, thus blurring the distinction between facts and rumors. This was especially visible during the COVID-19 outbreak, when rumours and disinformation spread throughout internet networks. Sentiment analysis and rumour categorization have developed as critical techniques for discriminating between authentic information and fake rumours in order to solve this problem. This survey research dives into sentiment analysis and hybrid two-tier meta-learning classification strategies for recognizing COVID-19-related rumour tweets. The paper opens with an overview of the pandemic's widespread disinformation and its negative consequences on public health and decision-making. Following that, it discusses the significance of sentiment analysis in determining the emotional tone of tweets, which greatly aids in rumour identification. The study also digs into the notion of hybrid two-tier meta-learning categorization, which is a revolutionary technique that combines the capabilities of standard machine learning with meta-learning. This hybrid technique attempts to improve the accuracy and robustness of rumour tweet categorization models by combining general knowledge learned from a variety of tasks with information specific to COVID-19 rumour detection. In addition, the article covers nearly 24 references several sentiment analysis approaches, such as lexicon-based, machine learning-based, and deep learning-based methods, emphasizing their merits and limitations in the context of COVID-19 rumour tweet detection. It also delves into the complexities of the hybrid two-tier meta-learning categorization technique, emphasizing its versatility and capacity to successfully tackle developing rumour patterns.

Keywords: Classification, Covid-19 Rumor Tweet Discovery, Sentiment Analysis, Two-Tier Meta-Learning

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I. INTRODUCTION

The quick spread of information and communication through social media platforms has revolutionized the way society consumes and distributes news in the digital era [1]. While allowing for the rapid dissemination of reliable information, this shift has also resulted in the spread of rumours and disinformation, with catastrophic implications, especially in crucial circumstances like as the COVID-19 epidemic [2]. The widespread dissemination of incorrect or misleading information not only adds to public confusion and dread, but it also makes informed decision-making by individuals, communities, and governments difficult [3]. The advent of the COVID-19 pandemic created a situation in which prompt and accurate information distribution was critical [4]. However, the info deluge abundance of both accurate and incorrect information—complicated the process of distinguishing facts from lies. In this context, the proactive detection and categorization of COVID-19-related rumour tweets has become an important field of study and technology intervention [5-7].

Sentiment analysis, a computer approach that includes the automated evaluation of emotional tones and attitudes displayed within text data, is crucial to attempts to counteract disinformation [8-11]. Sentiment analysis is critical in identifying not only the factual substance of a communication but also the underlying emotions linked with it in the instance of COVID-19-related rumour tweets [12-15]. Analysts may get deeper insights into the possible effect and legitimacy of information by evaluating attitudes such as dread, scepticism, or comfort. The particular character of rumour tweets, which often include aspects of dread, conjecture, and sensationalism, emphasises the need of including sentiment analysis in rumour identification. Sentiment analysis supplements existing classification algorithms by adding a layer of context that assists in discriminating between authentic and deceptive material [16-19].

Rumour tweet categorization is a complicated and dynamic issue that requires systems that can respond to changing patterns and innovative rumour narratives [20]. As a solution to this problem, a hybrid two-tier meta-learning classification appears as a potential option. This novel method combines the benefits of classic machine learning methods with meta-learning approaches [21-22]. Meta-learning, which is distinguished by its capacity to learn from many tasks, allows models to harness general information gathered from several domains and apply it to the particular goal of COVID-19 rumour detection. By combining these meta-learning capabilities with typical machine learning classifiers, the hybrid technique improves

classification accuracy and resilience by capturing the intricacies of emergent rumour patterns [23-24].

II. BACKGROUND STUDY

2.1 Survey on sentiment analysis

A.Alnawas (2022) Sentiment analysis in the Iraqi Arabic dialect was the focus of this research. In this investigation, the author looked at how incorporating deep learning into the sentiment analysis model might change things. Bi-directional Long Short Term Memory (Stacked Bi-LSTM) was utilized because it was a suitable approach for predicting emotions and extracting context from Arabic texts. To test the efficacy of the proposed model, experiments were run on the 1k labelled dataset. Common models were tested experimentally so that findings could be compared. The suggested model outperformed existing methods in all experimental settings. In addition, when compared to other approaches, the model has higher accuracy and F1-measure. Results like these were useful for advancing studies of sentiment analysis, the Arabic language, and the Iraqi Arabic dialect.

A.J. Nair et al. (2021) the author use three distinct methods for sentiment analysis: Logistic Regression, BERT, and VADER. The author has scaled the results of all three algorithms to lie between -1 and 1. This was done to ensure that the comparison was valid and can be easily spotted. When compared to Valence Aware Dictionary and sentiment Reasoned (VADER) and Logistic Regression, Bidirectional Encoder Representation from Transformers (BERT) has a higher percentage of correct predictions (92%). BERT's superior accuracy may be attributed to its focus on a particular grammatical feature of sentences. The polarity or tone of tweets was not a factor in logistic regression. It also takes a long time to analyze and receive the result since the author has applied these techniques to very vast data.

A.Qazi et al. (2022) Covid-19 has had a devastating effect on healthcare systems throughout the world, and has killed thousands of people. Twitter, as a thriving social media tool, has given people a safe space to freely express their emotions (both thankfulness and worries). It's worth noting that Twitter sentiment analysis may be a powerful tool for aligning public sentiments with the handling of public health crises. Thus, studies have categorized tweets related to the COVID-19 pandemic shutdown and used sentiment analysis to determine how the Pakistani public feels about the closure. Policy and strategy development in the face of a health emergency, such as the COVID-19 pandemic, relies heavily on sentiment analysis. Twitter

people in Pakistan were already responding positively to the shutdown, suggesting that the nation has been successful in transmitting the utmost precaution. The most popular phrases reflect a general sense of contentment at being able to spend time with loved ones during the COVID-19 pandemic lockdown. The use of words that convey negative emotions was regulated by the government in order to limit the spread of fear.

A.Tao et al. (2021) these authors research results corroborate Twitter's use as a media outlet for studying public opinion. It was advocated that mined sentiment be utilized in conjunction with current mass polls because of its similarity to Morning Consult, Twitter, and to a lesser degree, Reddit. When compared to conventional approaches, Machine learning sentiment analysis (MLSA) applied to Internet media has distinct advantages since it can quickly and cheaply measure the mood of a large audience. Beyond the scope of this investigation, a number of interesting questions arise. Although progress was hampered by variations in the quantity of data, future efforts should aim to standardize the volumes of mined data across all forms of online media. Labeling the training data may have introduced noise into this study; crowd sourcing labelled data should be used instead in future research. The use of a more robust model in further studies on the subject was also recommended. Facebook and other news sites, particularly those written in languages other than English, should be investigated to provide a broader global view of the issue. Additional source comparisons may potentially uncover information from different times and places.

B. Siswanto and Y. Dani (2021) Sentiment analysis has been shown to improve when translated lines were first translated into Indonesian, then run through the Sastrawi library, and then translated back into English. This method may be used to categories neutral feeling as either positive or negative. From the data collected on Twitter in 2021, the author can see that 52% of users had a favorable opinion of the oximeter when used as a screening tool for Covid-19 symptoms.

Imamah and F. H. Rachman (2020) the author conduct an experiment on the sentiment categorization of tweets from the covid-19 using word weighting and logistic regression. Using TF-IDF during extraction greatly improved sentiment analysis's ability to correctly categorise extracted text. The system has a reliability of 94.71%. Since the author were able to display the majority of tweets, the author know that the majority of individuals who discussed covid-19 had a neutral opinion. This suggests that global mental health was now stable and improving. Despite

the fact that some individuals were in the worried stage because they project too much negativity.

J. Nguyen and R. Chaturvedi (2020) In order to perform aspect-based sentiment analysis of COVID-19 Twitter tweets, the authors of this research developed a modified algorithm based on current approaches. Instead of using noisy sites like Twitter, the suggested enhancements focus on better extraction, aspect creation, and post categorization.

2.2 Survey on sentiment analysis and hybrid two-tier meta-learning classification

K. Saini et al. (2021) In this research, the author present the use of a Deep LSTM model that incorporates GloVe embeddings to conduct a textual analysis of tweets on the Corona virus. The purpose of this work was to provide a unique tool for uncovering the underlying emotion in microblogs. While most tweets had a neutral mood score, the data showed that around 17.67% of all tweets analysed were negative in tone. Fear, anger, and resentment were on the rise as a result of the epidemic, explaining these unpleasant tweets. Some of these unfavourable attitudes were born through the propagation of false information on social media, which in turn fuels global Sinophobia.

M. A. Alanezi and N. M. Hewahi (2020) Finally, k-means clustering was used to uncover patterns in people's reactions to the COVID-19 epidemic, providing a solution to the problem of public opinion. Most of the terms in the WHO and Bahrain ministry of health databases were related to COVID-19, suggesting that this disease has a socially isolating effect on individuals. More accounts will be made in 2020, as well. According to the data, the majority of tweets in the United States, Australia, Nigeria, Canada, and the United Kingdom were negative. However, the bulk of tweets in both Italy and India were supportive. This demonstrates that Italians and Indians were more upbeat about the epidemic than citizens of other nations.

M. A. Mudassir (2021) these authors research, the author propose evaluating the accuracies of the models using a manually annotated sample of tweets, and the author offer a thorough rationale for the choosing of model. A predetermined number of tweets must be picked from each day recorded in the dataset, as opposed to randomly selecting the sample, since this article recognises that specific events might result in a brief surge towards a certain emotion. In addition, the effectiveness of three sentiment analysis models has been compared in this work. This work seeks to remedy the prevalent reliance on VADER, Naive Bayes, TextBlob, and similar classifiers in the field of vaccination sentiment analysis, rather than ABSA models.

Table 1: Comparative Analysis of existing author methodology

Author	Year	Methodology	Advantage	Limitation
A.J. Nair, V. G and A. Vinayak	2021	Natural Language Processing	Traditional sentiment analysis techniques categorize tweets into broad positive, negative, or neutral classes.	The effectiveness of sentiment analysis models heavily depends on the quality and diversity of the training data.
A.Tao et al.	2021	supervised machine learning	Finding that Twitter's sentiment trends have the lowest deviation from the control survey implies that Twitter was a reliable indicator of public sentiment.	The sentiment expressed on platforms like Twitter and Reddit might not be representative of the entire population.
K. Saini et al.	2021	stacked LSTM	Utilizing a Stacked LSTM model and Stanford's pretrained GloVe embeddings demonstrates the integration of advanced natural language processing techniques into the analysis.	Sentiment analysis models can struggle with understanding nuances, sarcasm, and regional variations in language.
N. Gharpure et al.	2022	Multimodal Sentiment Analysis	Focusing on the pandemic's impact on mental health as a driving force gives your survey immediate relevance. It aligns with a critical issue that has garnered	Sentiment analysis and technology were rapidly evolving. The information captured in your survey might become outdated quickly, particularly as new

			significant attention, making your survey timely and pertinent.	techniques and models emerge.
R. Dumre et al.	2021	Natural language Processing	By analyzing social media posts, your study taps into real-time sentiments and reactions of the public as the pandemic unfolds.	Social media posts often contain slang, emojis, and colloquial language that can be challenging for sentiment analysis models.

M. R. Khan et al. (2022) Bangla Sentiment analysis was an emerging field, and it has been crucial to assessing public opinion on vaccination on a national scale in Bangladesh during Covid-19. This motivated us to tackle the challenge of enhancing Bangla language sentiment analysis as these authors primary research focus. These authors' findings suggest that a BERT-based classifier model, which includes a multilingual cased text processor, may significantly outperform more conventional models. The self-attention heads in the transformer-based BERT were what make contextual embedding of words possible. Overall, the accuracy of sentiment prediction was greatly improved by these authors work in creating a dataset collection with proper augmentation, assigning weights for each word based on context rather than TF-IDF, and training the entire embedded layer with these authors training dataset rather than reassigned weights in the regular BERT model.

M. Roque et al. (2022) Sentiment analysis of tweets about COVID-19 was shown with the use of bidirectional encoder representations from Transformers (BERT). A total of 31,987 tweets were utilised in the analysis, with the data being divided 80/10/10 across training, validation, and testing after initial cleaning. The BERT was trained using tokenized language from the tweets as input, and the resulting sentiment score (negative, neutral, or positive) was the output. The final model achieved an accuracy of 75.15 percent, and it performed very well when predicting tweets with negative sentiment but poorly when predicting tweets with neutral sentiment.

N. Gharpure et al. (2022) these authors research provided a holistic perspective by singling out pivotal players in terms of their influence and output, unveiling the most crucial

themes, their evolution and progression, and their distribution throughout different sorts of studies. More and more scholarly works have referenced or written on sentiment analysis in recent years. The findings of this research should promote progress across a number of fields and businesses. These might help researchers and management plan out where to put their efforts in future endeavours. Industry may use it to increase consumer satisfaction, staff productivity, and market expansion; the medical industry can use it to monitor patients' mental health; and the educational industry can use it to assist students gauge their own mental state while studying. Insight into the sentiment analysis field as a whole would be facilitated by these authors survey.

2.3 Survey on Sentiment Analysis for Covid-19 Rumor Tweet Discovery

N. R. Fauzan et al. (2021) More than 10 million individuals have lost their lives to the Covid-19 pandemic, and the virus has infected more than 100 million people. Covid-19 virus has no true "cure" at this time, however it may be prevented with a vaccination. However, on Twitter and other social media, many individuals share their thoughts, both in favour of and against the Covid-19 vaccination. Research conducted in the United States showed that only about 40%-60% of adults were interested in receiving Covid-19 vaccines, despite the fact that this number needs to reach 60%-70% in order to achieve HERD Immunity.

N. S. Devi and K. Sharmila (2021) Using the pre-processor software, this article calculates the text's fine-grained feature from publicly available tweets in real time. The vocabulary of Vader's emotions was used. Linear SVC, linear SVM, and Naive bayes were used to determine how accurate the Twitter data was. When compared against other algorithms, the Naive Bayes method performs the best. Propaganda dissemination in times of epidemic and disaster: future work must be done. The goal of future research was to use multimodal feature extraction from twitter data to detect social media-related bogus tweets.

R. Dumre et al. (2021) The COVID-19 epidemic has had far-reaching effects on people's daily lives. Because of its enormous population, India was among the nation's worst hit. Many people in India were using social media to share their thoughts on the outbreak. Sentiment analysis and other forms of natural language processing allow us to assess how people feel about different aspects of the epidemic. The VADER emotion was also used. The results of this research showed that the people of India want to be vaccinated but have run into problems with the availability of vaccinations. It was up to the various state governments to investigate this matter. Most tweets regarding oxygen in India were upbeat, with topics like companies donating

oxygen tanks and new oxygen plants being built. People's willingness to volunteer and donate to support oxygenation initiatives has contributed to the upbeat mood. Twitter users expressed their disappointment with those who disobeyed the lockdown's guidelines.

R. Latifah et al. (2021) the purpose of this study was to gauge public opinion about COVID-19 vaccinations. While other research has covered similar ground, this study utilized a fresh Twitter dataset, examined numerous classifiers, and used the model to categories not just unlabeled Twitter data but also news headline data pertaining to COVID-19 vaccinations. The F1-measure and overall macro average accuracy of a classifier were taken into consideration when selecting the best one. Support Vector Machine was selected as the classifier because to its 84% accuracy and 0.76 macro-average F1-measure.

R. Renaldy et al. (2021) one field that may be utilized to evaluate the substance of an opinion text was known as sentiment analysis. Existing opinion writings may be categorized based on the findings of the sentiment analysis. The data analyzed in the study shows that the majority of people have an optimistic outlook (1879 tweets) whereas just 1706 tweets have a negative outlook. The ensemble stacking technique was used to classify labelled data, and it achieves an accuracy of 85.6%. Twitter data on many issues, such as immunizations, the new normal, and other things, may be used in future studies. Additional study may be conducted by using non-stacking ensemble techniques as bagging, boosting, and voting.

S.A. Jubayer and S. Akter Hafsha (2022) This survey collects information on how people in Bengali feel about being vaccinated against COVID-19. Several machine learning classifiers have been applied to these authors process dataset, with Logistic Regression (LR) achieving the best accuracy (80.77%) and generally receiving favorable reviews. The vast majority of Bangladeshi internet users were pleased with the country's immunization initiatives, as shown by this response. For a first attempt, the author can already satisfy several requirements. Accuracy has dropped dramatically because of the Bengali dataset's unavailability and the discrepancy in data frequencies. One way to improve accuracy was to have a specialist in the field manually identify the data. To properly convey one's feelings, emoticons were a must-have. Emoticons may be used to enhance sentiment analysis. It was possible to improve accuracy performance, for example, by investigating various preprocessing techniques.

V. Jagadishwari and N. Shobha (2022) People's thoughts towards Covid-19 vaccines have been analyzed here. Text blob was used to gather and analyze tweets in order to determine

how individuals were feeling. The examination focused on the United States of America and India. The average level of opinion in both nations was agnostic. The public's opinion on various vaccinations was also evaluated. When compared to modern, early public opinion of Pfizer in the United States was more unfavorable. When first introduced, people in India were skeptical about all vaccinations, not only the ones against smallpox. Later on, opinions were mostly upbeat or neutral. Average polarity for Covishelid was 0.45, with Coaxing coming in at 0.4. Indians had varying reactions to the Sputnik vaccine developed by the Russians.

X. Yang and V. Sornlertlamvanich (2021) Leading vaccines in the UK, US, and Japan were made by Pfizer, AstraZeneca, and Moderna, respectively, however Japan has suspended usage of AstraZeneca due to a series of medical mishaps. Text Blob was utilized to analyze the phrases for both the UK and US, and Text Blob's NavieBays categorization significantly increases accuracy. The data analysis shows that the general public's opinion of the three vaccinations was favorable and non-threatening, with few negative feelings. Pfizer topped the list of companies inspiring hope, followed closely by Modern Vaccines. With increased security and enough real vaccine manufacturing, both vaccines might be marketed even further. Sentiment analysis text in Japanese was more practical and efficient than other machine learning approaches when applied to Japanese tweets. Emotion words and their related feelings were edited and summarized so that the attitudes and emotions represented in the sentences may be compared and analyzed.

Y. Mei and Y. Wang (2023) these authors research uses the deep learning model BERT to provide more precise sentiment analysis findings via a comparison of its strengths in word embedding training. Here were two points that sum up the study's significance: Examining the BERT model and the Embedding layer in terms of their ability to classify sentiment, therefore resolving the issue of one-way information flow in the pre-training model and drastically simplifying the neural network. Data-driven visualization of the emotional shifts experienced by netizens throughout the COVID-19 pandemic reveals widespread popular optimism. Word2Vec and Glove were two examples of popular models that can be compared in the future to obtain more accurate word embedding models, and other forms of neural networks can be built with the Keras library to improve performance.

III. DISCUSSION

The survey's new sentiment analysis and hybrid two-tier meta-learning classification algorithms provide potential answers to the difficulty of finding COVID-19-related rumour tweets in the fast-paced social media arena. These approaches exhibit the ability to discriminate between authentic material and disinformation by measuring emotional tones via sentiment analysis and integrating general knowledge with domain-specific expertise in the hybrid approach. The adaptability of the hybrid two-tier meta-learning classification technique is particularly important in battling developing rumours and narratives during crises, given the dynamic nature of misinformation transmission. These techniques considerably contribute to the development of reliable and adaptive rumour detection systems, so helping informed decision-making and public health activities while also motivating discussion of ethical concerns and future research options in the area. Sentiment analysis has shown to be an effective approach for categorizing rumor tweets. Sentiment analysis adds value beyond just determining the factual correctness of information by assessing the underlying emotions and opinions represented in tweets. Because emotionally charged information tends to catch greater attention and participation, the emotional context may have a substantial influence on the dissemination and acceptance of rumours. Various sentiment analysis methodologies were mentioned in the poll, each with its own set of benefits and drawbacks. Lexicon-based techniques give sentiment ratings to terms in tweets using established sentiment dictionaries, resulting in a rapid and interpretable analysis. Machine learning-based approaches, on the other hand, allow for the extraction of complicated patterns from textual data, hence improving accuracy. Deep learning algorithms, such as recurrent neural networks (RNNs) and transformers, excel at capturing subtle attitudes and context, although they may need larger labelled datasets and processing resources.

IV. CONCLUSIONS

Finally, the intersection of social media's quick information dissemination with the difficulty of disinformation, particularly during the COVID-19 epidemic, highlights the critical need for effective methods to distinguish truth from lie. This study revealed the importance of sentiment analysis and hybrid two-tier meta-learning classification in addressing the problem of finding COVID-19-related rumour tweets. These approaches show considerable promise in differentiating authentic information from false material by recognising emotional subtleties via sentiment analysis and exploiting the hybrid approach's combination of general and particular knowledge. The hybrid two-tier meta-learning classification method's dynamic character is

especially useful in tackling the ever-changing terrain of rumour trends, allowing for quick changes to shifting patterns. As we progress, these approaches will be critical pillars in the development of flexible and dependable rumour detection systems, providing a road to informed decision-making, protecting public health, and limiting the effect of disinformation. However, in an increasingly linked world, it is critical to evaluate the ethical implications of these breakthroughs and seek options for continuing study and innovation to bolster our defence against the spread of rumours.

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