

1. Introduction

The modern world is inseparable from technology, which spans everything from everyday objects to significant innovations, starting from the use of social media applications, the growing popularity of online shopping, and communication technologies like text messaging, chat rooms, mobile phones, the internet, and social networking services [1],[2]. According to a report by Hootsuite and We Are Social, 5.07 billion people worldwide are internet users, which is 63% of the 7.99 billion people worldwide [3]. In addition to its positive effects on society, the internet has certain detrimental implications, one of which is the development of cyberbullying [3]. Cyberbullying has emerged as one of the most significant issues associated with social media in recent years [4]. The phrase "cyberbullying" or "cyber-harassment" refers to harassment or bullying that occurs online. Cyberbullying, often known as online bullying, has grown in frequency, especially among youths [5]. The impact on victims of cyberbullying is profound and potentially dangerous. Beyond causing emotional distress, it can significantly affect their mental health, leading to feelings of depression, sadness, and frustration, which may escalate into severe psychological issues [5].

Text analysis has been the subject of considerable research on cyberbullying over the past few decades. Al et al. [6] presented a set of Platform X derived attributes. such as, user behaviour and tweet content. They are using a supervised machine learning approaches to identify instances of cyberbullying within Platform X networks. Based on their proposed methodology, the detection system obtained an area under the receiver operating characteristic (ROC) curve of 0.943 and an F-measure of 0.936 [7]. The Ruminati project was carried out by Massachusetts Institute of Technology [8], in detecting cyberbullying from YouTube comments by using Support Vector Machines (SVM). By including social characteristics, the researcher integrated detection with common sense thinking. The project results demonstrated an improvement in the accuracy of applying probabilistic modeling, reaching 66.7% [4]. Reynolds et al. [9] devised a language-based technique for detecting cyberbullying that has an accuracy of 78.5%.

Previous research identified instances of cyberbullying and evaluated how well the CNN and GNN algorithms detect cyberbullying on Platform X. Muhammad Rizki Nurfiqri et al. 2024 [10], demonstrate that GNN beats CNN, with average experimental results indicating that GNN obtains better values across all metrics. CNN obtains just 68.43% accuracy after 20 epochs, but GNN achieves 80.25%. Similarly, GNN consistently performs well in precision, recall, and F1-Score [10]. This demonstrates how GNN can account for context and intricate interactions between comments within graphical representations. In the study by Pramono et al. 2024 [11], it was found that while the model training duration grows with the number of epochs, the efficacy and evaluation results also improve. At 50 epochs, both GCN and GAT perform at their best, with GAT having an accuracy of 92.41% and GCN achieving 91.85%. Although both outcomes are relatively positive, GAT outperforms GCN [11].

Several previous studies have shown that the GCN and GAT methodologies effectively execute a range of objectives. However, a comprehensive study published in the journal "A Review of Graph Neural Networks: Concepts, Architectures, Techniques, Challenges, Datasets, Applications, and Future Directions" [12] showed that GCN could integrate more complex graph structures into more complex structures. This method is highly dependent on the graph structure used. In certain situation with complex or dynamic graph structures, these dependencies can constrain the flexibility and application of GCN [12]. GCN's reliance on graph structures can be challenging in some situations. Therefore, more research is needed to understand how well these two algorithms can be optimized for detecting cyberbullying,

especially for datasets with more complex graph structures. This study investigates the use of GCN and GAT algorithms in cyberbullying scenarios. It provides an overview for future researchers looking to apply graph machine learning to a various of challenges