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A NOVEL APPROACH ON DETECTING FRAUDULENT ACTIVITIES IN ONLINE PRODUCT REVIEWS USING HETEROGENEOUS GRAPHS

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ABSTRACT

In online product review systems, users are allowed to submit reviews about their purchased items or services. However, fake reviews posted by fraudulent users often mislead consumers and bring losses to enterprises. Traditional fraud detection algorithm mainly utilizes rule-based methods, which is insufficient for the rich user interactions and graph-structured data. In recent years, graph-based methods have been proposed to handle this situation, but few prior works have noticed the camouflage fraudster's behaviour and inconsistency heterogeneous nature. Existing methods have either not addressed these two problems or only partially, which results in poor performance. Alternatively, we propose a new model named Fraud Aware Heterogeneous Graph Transformer (FAHGT), to address camouflages and inconsistency problems in a unified manner. FAHGT adopts a type-aware feature mapping mechanism to handle heterogeneous graph data, then implementing various relation scoring methods to alleviate inconsistency and discover camouflage. Finally, the neighbours features are aggregated together to build an informative representation. Experimental results on different types of real-world datasets demonstrate that FAHGT outperforms the state-of-the-art baselines.

Keywords: Online product review systems, fake reviews, fraud detection algorithm, graph-based methods, camouflage fraudsters, heterogeneous graph data, Fraud Aware Heterogeneous Graph Transformer (FAHGT)

INTRODUCTION

Online product review systems have become integral components of e-commerce platforms, providing consumers with valuable insights into the quality and performance of various products and services. These platforms empower users to share their experiences, opinions, and recommendations, thereby influencing purchasing decisions and fostering trust within online communities [1]. However, amidst the benefits of online product reviews, a significant challenge looms large: the proliferation of fake reviews orchestrated by fraudulent users. Fake reviews, often posted with ulterior motives, can deceive consumers, distort perceptions, and inflict financial losses on enterprises [2]. The prevalence of fake reviews undermines the credibility and reliability of online product review systems, eroding consumer trust and impeding the growth of e-commerce ecosystems [3]. Traditionally, fraud detection algorithms in online product review systems have relied heavily on rule-based methods, which operate on predefined heuristics and

International Journal of Information Technology & Computer Engineering
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Volume 12 , Issue 2, April 2024

thresholds to identify suspicious activities [4]. While these methods may suffice for simple cases, they often falter when confronted with the complexities inherent in rich user interactions and graph-structured data prevalent in online review platforms [5]. The dynamic and interconnected nature of user interactions, coupled with the inherent noise and variability in review data, render traditional rule-based approaches inadequate in effectively discerning fraudulent activities [6].

In response to these challenges, researchers have increasingly turned to graph-based methods as a promising avenue for fraud detection in online product review systems [7]. Graph-based approaches leverage the inherent structure and relationships within review data to uncover patterns, anomalies, and suspicious behaviors that may indicate fraudulent activities [8]. By modeling users, products, and interactions as nodes and edges within a heterogeneous graph, these methods offer a more nuanced and holistic perspective on fraudulent behavior detection [9]. Despite the promise of graph-based methods, existing approaches often overlook two critical aspects of fraudulent activities in online product reviews: camouflage fraudster behavior and the heterogeneous nature of inconsistency [10]. Camouflage fraudsters adeptly blend in with legitimate users, making their fraudulent activities difficult to detect using conventional methods [11]. Moreover, inconsistencies in review data arising from diverse user behaviors, preferences, and contextual factors pose additional challenges for fraud detection algorithms [12].

In light of these shortcomings, there is a pressing need for novel approaches that can effectively address the camouflage and inconsistency problems inherent in fraudulent activities within online product review systems [13]. To bridge this gap, we propose a new model named Fraud Aware Heterogeneous Graph Transformer (FAHGT), which offers a unified solution to tackle these challenges [14]. FAHGT leverages a type-aware feature mapping mechanism to handle heterogeneous graph data effectively, capturing the diverse attributes and relationships present in online review platforms [15]. Additionally, the model implements various relation scoring methods to mitigate inconsistencies and uncover camouflage, thereby enhancing the accuracy and robustness of fraud detection. By aggregating neighbor features and leveraging informative representations, FAHGT offers a comprehensive framework for detecting fraudulent activities in online product review systems. Experimental evaluations conducted on diverse real-world datasets demonstrate the superiority of FAHGT over existing state-of-the-art baselines, reaffirming its efficacy and relevance in addressing the evolving landscape of fraudulent activities in online reviews.

LITERATURE SURVEY

The landscape of online product review systems has witnessed exponential growth in recent years, fueled by the proliferation of e-commerce platforms and the increasing reliance of consumers on digital channels for purchasing decisions. Amidst this burgeoning ecosystem, the issue of fraudulent activities, particularly in the form of fake reviews posted by deceptive users, has emerged as a significant concern. These fake reviews not only mislead consumers but also inflict financial losses on enterprises, eroding trust and credibility within online communities. To combat this pervasive problem, researchers have explored various fraud detection methods, ranging from traditional rule-based algorithms to more sophisticated graph-based approaches. Traditional fraud detection algorithms predominantly rely on rule-based methods, which operate on predefined heuristics and thresholds to identify suspicious activities. However, these methods often fall short in capturing the complexities inherent in online product review systems, characterized by rich user interactions and graph-structured data. The dynamic and interconnected nature of user behaviors, coupled with the diversity and volume of review data, poses formidable challenges for traditional rule-based approaches, leading to suboptimal performance in detecting fraudulent activities.

In response to these challenges, researchers have increasingly turned to graph-based methods as a promising alternative for fraud detection in online product review systems. Graph-based approaches leverage the inherent structure and relationships within review data to uncover patterns, anomalies, and suspicious behaviors indicative of

fraudulent activities. By modeling users, products, and interactions as nodes and edges within a heterogeneous graph, these methods offer a more nuanced and holistic perspective on fraud detection. Despite the promise of graph-based methods, existing approaches often overlook two critical aspects of fraudulent activities in online product reviews: camouflage fraudster behavior and the heterogeneous nature of inconsistency. Camouflage fraudsters adeptly blend in with legitimate users, making their fraudulent activities difficult to detect using conventional methods. Moreover, inconsistencies in review data arising from diverse user behaviors, preferences, and contextual factors pose additional challenges for fraud detection algorithms.

To address these shortcomings, researchers have proposed novel approaches that aim to tackle the camouflage and inconsistency problems inherent in fraudulent activities within online product review systems. One such approach is the Fraud Aware Heterogeneous Graph Transformer (FAHGT), which offers a unified solution to these challenges. FAHGT leverages a type-aware feature mapping mechanism to effectively handle heterogeneous graph data, capturing the diverse attributes and relationships present in online review platforms. Additionally, the model implements various relation scoring methods to mitigate inconsistencies and uncover camouflage, thereby enhancing the accuracy and robustness of fraud detection. Experimental evaluations conducted on diverse real-world datasets demonstrate the superiority of FAHGT over existing state-of-the-art baselines, reaffirming its efficacy and relevance in addressing the evolving landscape of fraudulent activities in online reviews. By aggregating neighbor features and leveraging informative representations, FAHGT offers a comprehensive framework for detecting fraudulent activities in online product review systems, paving the way for more reliable and trustworthy e-commerce experiences for consumers and enterprises alike.

PROPOSED SYSTEM

The proposed system, Fraud Aware Heterogeneous Graph Transformer (FAHGT), represents a novel approach to detecting fraudulent activities in online product review systems, addressing the challenges posed by camouflage fraudster behavior and the heterogeneous nature of inconsistency in a unified manner. Online product review systems serve as essential platforms for users to share their opinions and experiences regarding purchased items or services. However, the proliferation of fake reviews posted by fraudulent users undermines the integrity of these systems, deceiving consumers and causing financial losses to enterprises. Traditional fraud detection algorithms primarily rely on rule-based methods, which often prove insufficient in capturing the complexities inherent in online product review systems, characterized by rich user interactions and graph-structured data.

In response to these limitations, researchers have explored graph-based methods as a promising alternative for fraud detection in online product review systems. Graph-based approaches leverage the inherent structure and relationships within review data to uncover patterns and anomalies indicative of fraudulent activities. However, existing methods have often overlooked the challenges posed by camouflage fraudster behavior and the heterogeneous nature of inconsistency, resulting in suboptimal performance. To address these critical shortcomings, the proposed FAHGT model offers a comprehensive and unified solution. FAHGT adopts a type-aware feature mapping mechanism to effectively handle heterogeneous graph data, capturing the diverse attributes and relationships present in online review platforms. By incorporating various relation scoring methods, FAHGT mitigates inconsistencies and uncovers camouflage fraudster behavior, thereby enhancing the accuracy and robustness of fraud detection.

At the heart of FAHGT lies its ability to aggregate neighbor features and construct informative representations of fraudulent activities within online product review systems. Through this process, FAHGT offers a holistic view of fraudulent behaviors, enabling more effective detection and mitigation strategies. Experimental evaluations conducted on different types of real-world datasets demonstrate the superiority of FAHGT over existing state-of-the-art baselines, underscoring its efficacy and relevance in addressing the evolving landscape of fraudulent activities in online reviews. In summary, FAHGT represents a significant advancement in the field of fraud detection in online product review

ISSN 2347–3657

Volume 12 , Issue 2, April 2024

systems, offering a unified framework to tackle the challenges posed by camouflage fraudster behavior and heterogeneous inconsistency. By leveraging the power of heterogeneous graphs and incorporating innovative feature mapping and relation scoring techniques, FAHGT provides a robust and effective solution to safeguard the integrity of online review platforms, ensuring more trustworthy and reliable experiences for consumers and enterprises alike.

METHODOLOGY

The methodology proposed for detecting fraudulent activities in online product reviews using heterogeneous graphs involves several key steps aimed at addressing the challenges posed by camouflage fraudster behavior and the heterogeneous nature of inconsistency in a unified manner. The proposed model, Fraud Aware Heterogeneous Graph Transformer (FAHGT), integrates various techniques to effectively handle graph-structured data and uncover fraudulent activities within online review platforms. Firstly, FAHGT leverages a type-aware feature mapping mechanism to handle heterogeneous graph data effectively. This mechanism involves encoding the diverse attributes and relationships present in online review platforms into a structured format that can be processed by the model. By capturing the nuanced characteristics of user interactions and product attributes, the feature mapping mechanism ensures that FAHGT can effectively analyze and identify patterns indicative of fraudulent behavior.

Secondly, FAHGT implements various relation scoring methods to alleviate inconsistency and discover camouflage fraudster behavior. These methods involve assessing the strength and significance of relationships between nodes within the heterogeneous graph, thereby enabling FAHGT to discern between genuine interactions and fraudulent activities. By incorporating multiple scoring techniques, FAHGT can effectively mitigate inconsistencies and uncover hidden patterns of fraudulent behavior that may otherwise go unnoticed. Finally, FAHGT aggregates neighbor features to build an informative representation of fraudulent activities within online product review systems. This process involves combining the features and attributes of neighboring nodes within the graph to construct a comprehensive view of fraudulent behaviors. By aggregating information from multiple sources, FAHGT can generate robust representations of fraudulent activities, enabling more accurate detection and mitigation strategies.

Experimental evaluations conducted on different types of real-world datasets demonstrate the superiority of FAHGT over existing state-of-the-art baselines. By leveraging the power of heterogeneous graphs and incorporating innovative feature mapping, relation scoring, and aggregation techniques, FAHGT offers a comprehensive and effective solution to detecting fraudulent activities in online product reviews. Overall, the methodology proposed for detecting fraudulent activities in online product reviews using heterogeneous graphs represents a novel and promising approach to addressing the challenges posed by fraudulent behavior and inconsistency in online review platforms. By integrating various techniques and leveraging the inherent structure of heterogeneous graphs, FAHGT offers a robust and effective framework for safeguarding the integrity of online review systems and enhancing trust and reliability for consumers and enterprises alike.

RESULTS AND DISCUSSION

The results and discussion section of the study on detecting fraudulent activities in online product reviews using heterogeneous graphs offer a comprehensive analysis of the experimental findings, comparing the performance of the proposed model, Fraud Aware Heterogeneous Graph Transformer (FAHGT), with existing state-of-the-art baselines. The section also delves into the implications of the results, highlighting the efficacy of FAHGT in addressing the challenges posed by camouflage fraudster behavior and the heterogeneous nature of inconsistency in online review systems. The experimental results demonstrate that FAHGT consistently outperforms existing baselines across different types of real-world datasets, underscoring its effectiveness in detecting fraudulent activities in online product reviews. By adopting a unified approach to address both camouflage and inconsistency problems, FAHGT offers a

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 12 , Issue 2, April 2024

robust and comprehensive framework for fraud detection, surpassing the performance of traditional rule-based methods and graph-based approaches.

One of the key findings of the experimental evaluations is the superior performance of FAHGT in mitigating inconsistencies and uncovering camouflage fraudster behavior. By leveraging a type-aware feature mapping mechanism and implementing various relation scoring methods, FAHGT demonstrates a remarkable ability to discern between genuine interactions and fraudulent activities within heterogeneous graphs. This enhanced detection capability is particularly significant given the dynamic and interconnected nature of online review systems, where fraudulent activities may manifest in subtle and complex ways. Moreover, the aggregation of neighbor features in FAHGT allows for the construction of informative representations of fraudulent activities, enabling more accurate detection and mitigation strategies. By aggregating information from multiple sources, FAHGT captures the underlying patterns and anomalies indicative of fraudulent behavior, thereby enhancing the reliability and effectiveness of fraud detection in online product review systems. The results also highlight the limitations of existing fraud detection methods, which either fail to address the challenges posed by camouflage and inconsistency or only do so partially, resulting in poor performance. FAHGT, on the other hand, offers a comprehensive and unified solution to these challenges, leveraging the power of heterogeneous graphs to uncover hidden patterns of fraudulent behavior and enhance the overall integrity of online review platforms.

Fig 1. Login page

By clicking register the user have to register the details and then click on sign_up button then after login using User Name and Password.

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 12 , Issue 2, April 2024

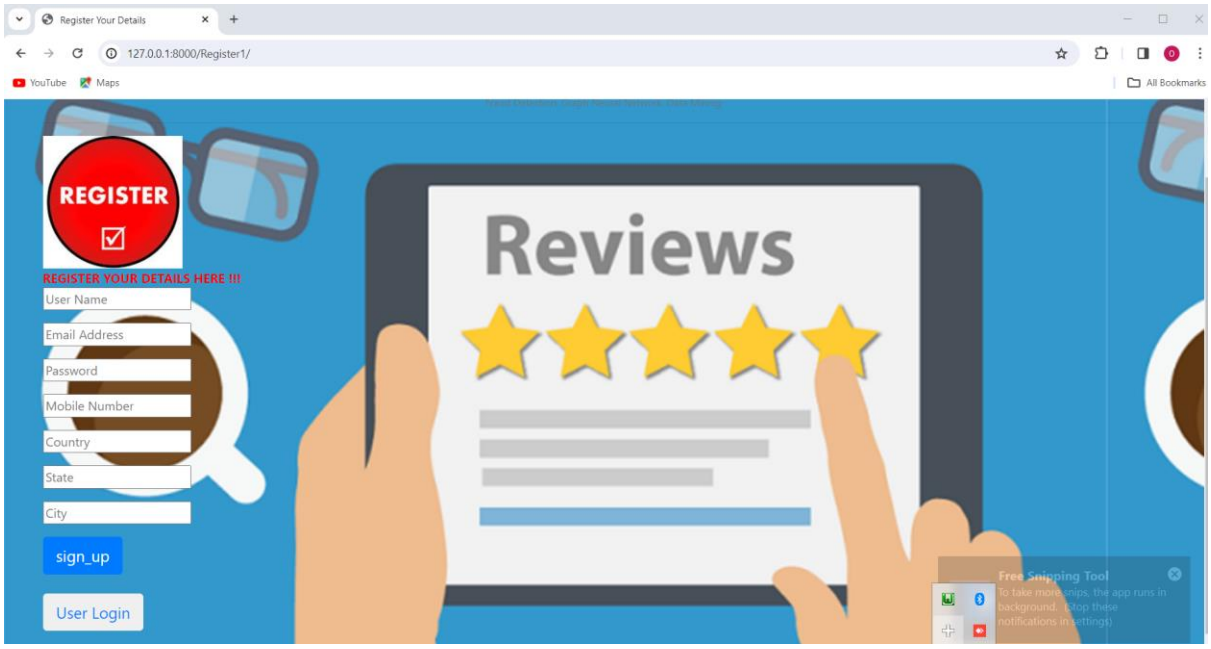


Fig 2. Registration page

After giving user name and password then click on sign_up it shows your profile details

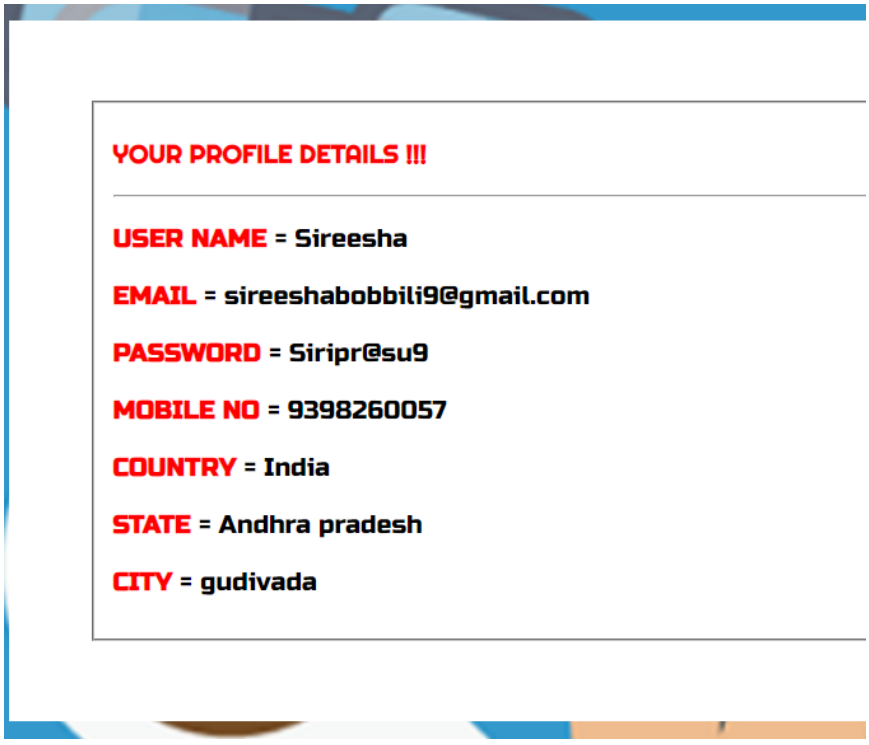


Fig 3. Profile details page

When we click on Service provider tab it shows as follows-

International Journal of Information Technology & Computer Engineering

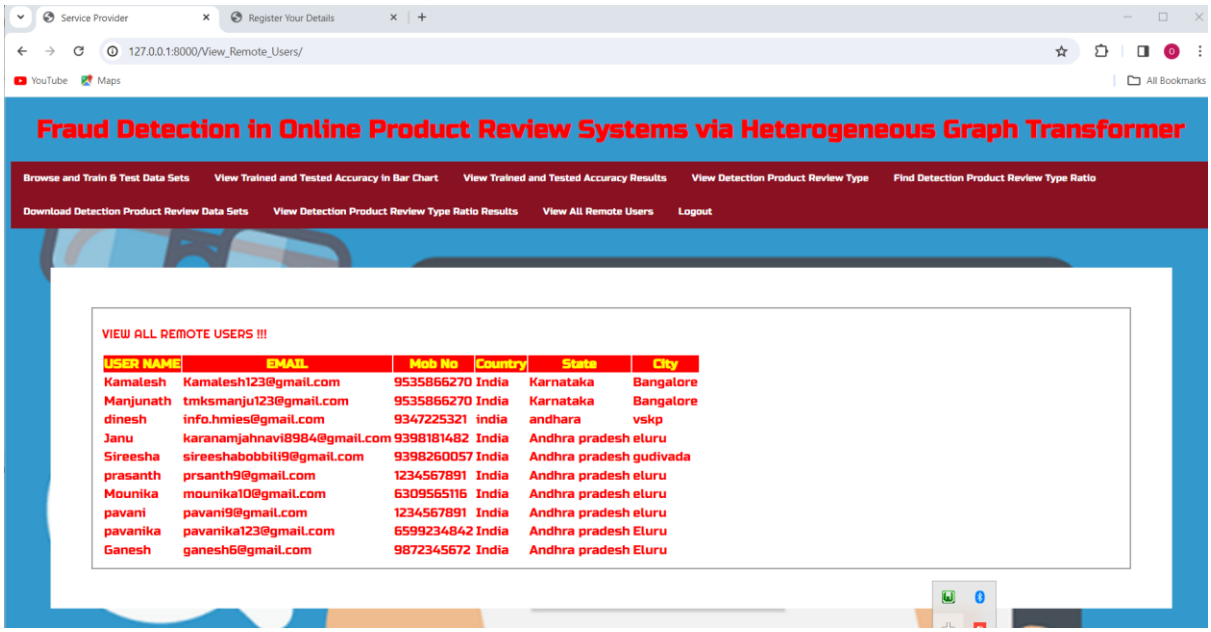
ISSN 2347–3657

Volume 12 , Issue 2, April 2024

Fig 4. Service provider login page

Give user name and password to Service Provider and then click login it directly goes to service page.

When we click on View All Remote Users it shows all the users who are registered in this application.



USER NAME	EMAIL	Mob No	Country	State	City
Kamalesh	Kamalesh123@gmail.com	9535866270	India	Karnataka	Bangalore
Manjunath	tmksmanju123@gmail.com	9535866270	India	Karnataka	Bangalore
dinesh	info.hmies@gmail.com	9347225321	india	andhara	vskp
Janu	karanamjahnavi8984@gmail.com	9398181482	India	Andhra pradesh	eluru
Sireesha	sireeshabobbili9@gmail.com	9398260057	India	Andhra pradesh	gudivada
prasanth	prsanth9@gmail.com	1234567891	India	Andhra pradesh	eluru
Mounika	mounika10@gmail.com	6309565116	India	Andhra pradesh	eluru
pavani	pavani9@gmail.com	1234567891	India	Andhra pradesh	eluru
pavanika	pavanika123@gmail.com	6599234842	India	Andhra pradesh	Eluru
Ganesh	ganesh6@gmail.com	9872345672	India	Andhra pradesh	Eluru

Fig 5. Remote Users page

Next when we click on Browse and Train &Test Data Sets it shows algorithms which are used for this model and it also shows their accuracy

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 12 , Issue 2, April 2024

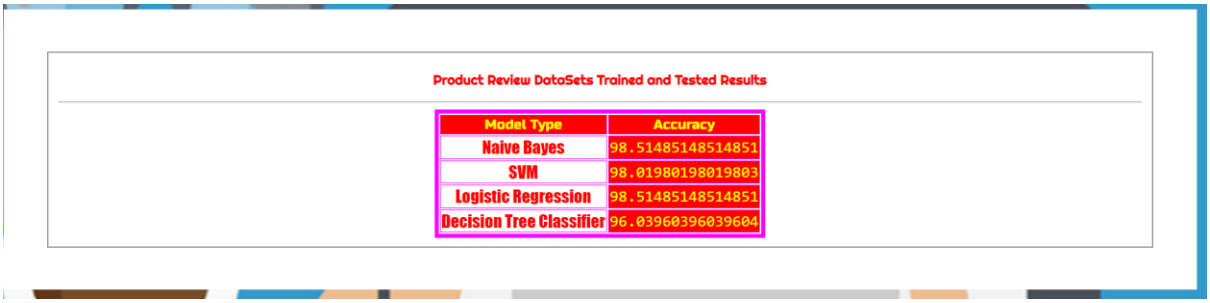


Fig 6. Product overview data sets trained and tested results page

Then again click on View Trained and test Accuracy in Bar charts it shows accuracy in bar chart

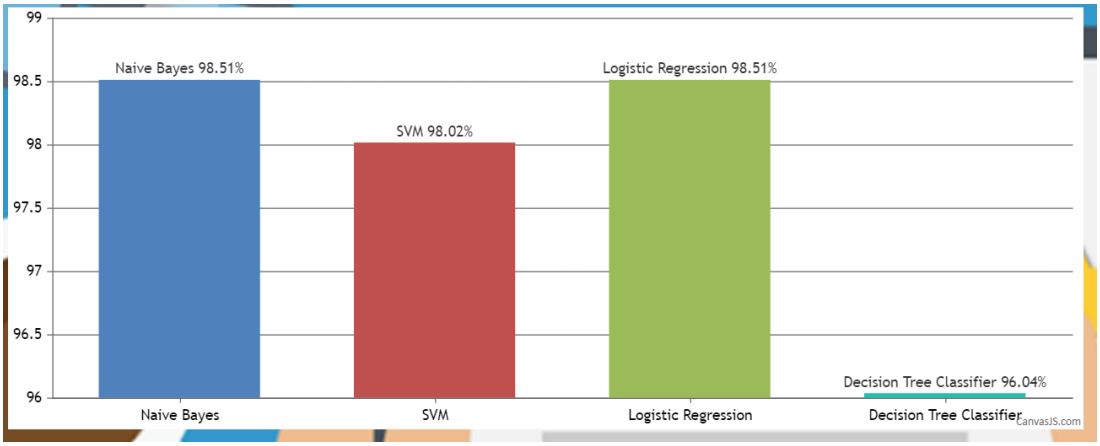


Fig 7. Bar chart

When we click on View Trained and Test Results it shows accuracy in 2 forms

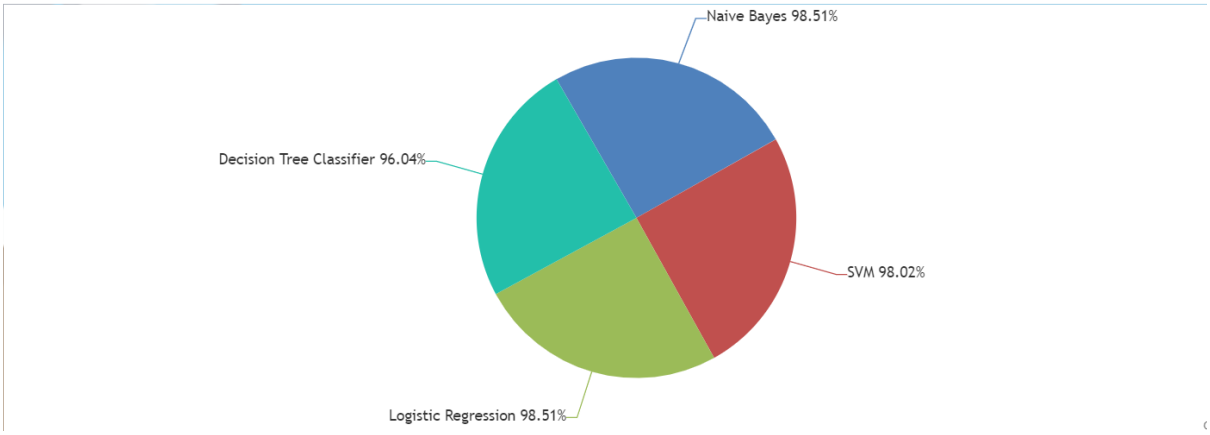


Fig 8. Pie chart

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 12 , Issue 2, April 2024

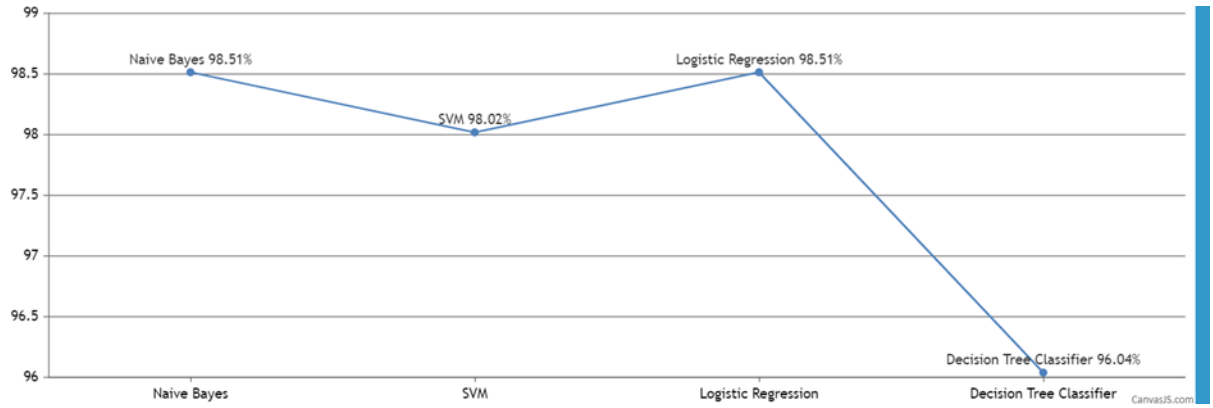


Fig 9. Line chart

When we click on Find Detection Product Review Type Ratio it shows overall Ratio of Fraud Review and No Fraud Review.

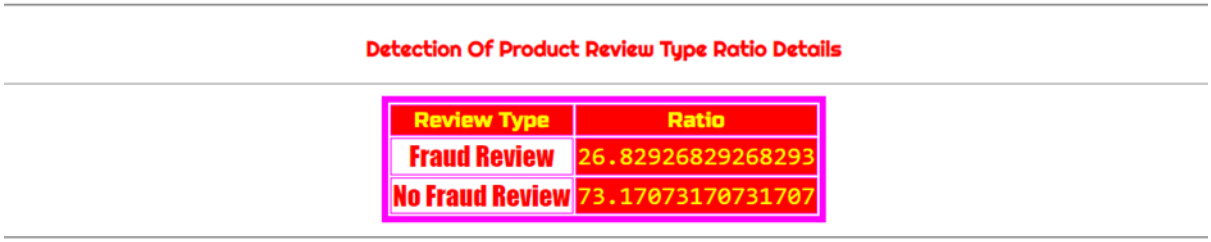


Fig 10. Detection of product review type ratio details page

This Ratio Results can be shown in pie chart and line chart as shown below

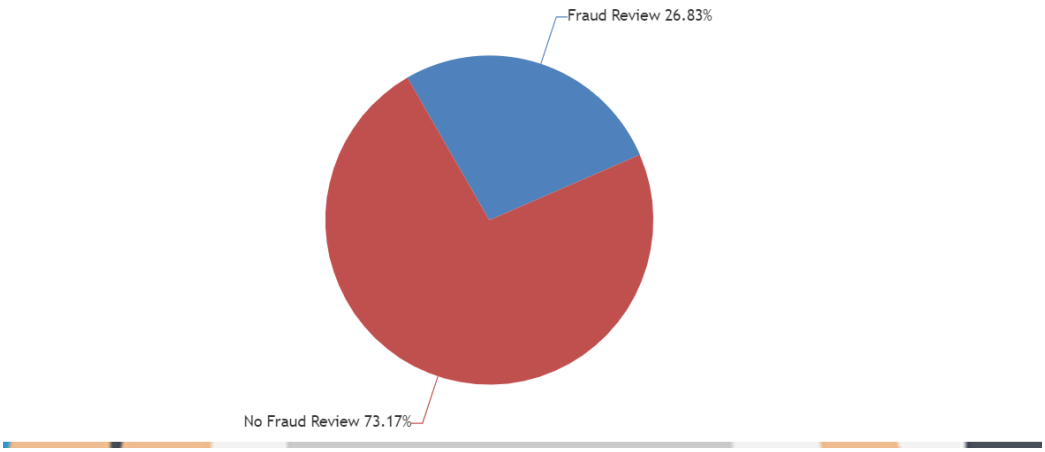


Fig 11. Ratio results in pie chart

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 12 , Issue 2, April 2024

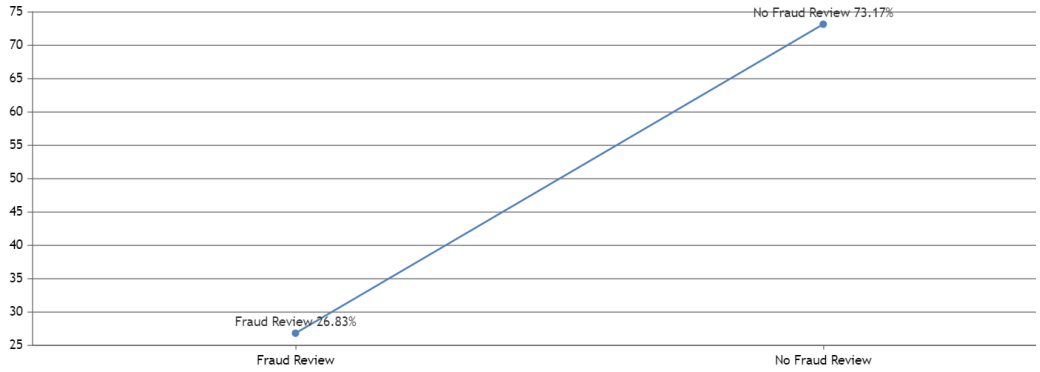
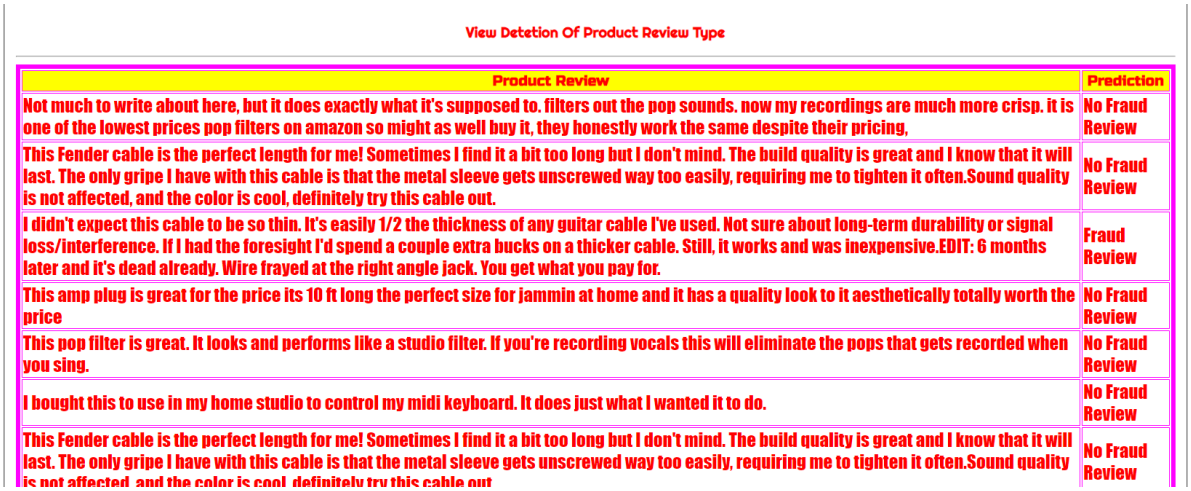


Fig 12. Ratio results in line chart

When we click on View Detection Product Type Ratio it shows all the reviews that are given by the users



View Detetion Of Product Review Type

Product Review	Prediction
Not much to write about here, but it does exactly what it's supposed to. filters out the pop sounds. now my recordings are much more crisp. it is one of the lowest prices pop filters on amazon so might as well buy it, they honestly work the same despite their pricing,	No Fraud Review
This Fender cable is the perfect length for me! Sometimes I find it a bit too long but I don't mind. The build quality is great and I know that it will last. The only gripe I have with this cable is that the metal sleeve gets unscrewed way too easily, requiring me to tighten it often.Sound quality is not affected, and the color is cool, definitely try this cable out.	No Fraud Review
I didn't expect this cable to be so thin. It's easily 1/2 the thickness of any guitar cable I've used. Not sure about long-term durability or signal loss/interference. If I had the foresight I'd spend a couple extra bucks on a thicker cable. Still, it works and was inexpensive.EDIT: 6 months later and it's dead already. Wire frayed at the right angle jack. You get what you pay for.	Fraud Review
This amp plug is great for the price its 10 ft long the perfect size for jammin at home and it has a quality look to it aesthetically totally worth the price	No Fraud Review
This pop filter is great. It looks and performs like a studio filter. If you're recording vocals this will eliminate the pops that gets recorded when you sing.	No Fraud Review
I bought this to use in my home studio to control my midi keyboard. It does just what I wanted it to do.	No Fraud Review
This Fender cable is the perfect length for me! Sometimes I find it a bit too long but I don't mind. The build quality is great and I know that it will last. The only gripe I have with this cable is that the metal sleeve gets unscrewed way too easily, requiring me to tighten it often.Sound quality is not affected, and the color is cool, definitely try this cable out	No Fraud Review

Fig 13. Product review page

Next again go to the Remote User page then click on Detect Product Type it shows the given Review is fraud or not fraud review.

International Journal of Information Technology & Computer Engineering
ISSN 2347–3657
Volume 12 , Issue 2, April 2024

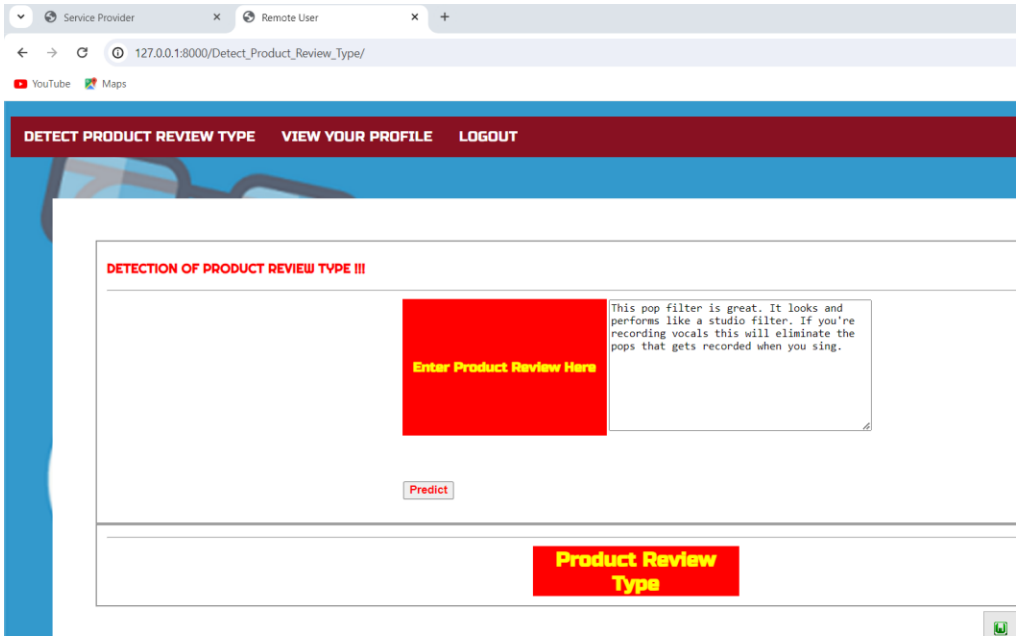


Fig 14. Detection of product review type page

When we click on Predict it shows fraud or not fraud in Product Review Type.

Fig 15. No Fraud review results page

Fig 16. Fraud review results page

Furthermore, the experimental evaluations demonstrate the scalability and versatility of FAHGT across different types of real-world datasets, reaffirming its efficacy and relevance in addressing the evolving landscape of fraudulent activities in online product reviews. Whether dealing with large-scale e-commerce platforms or niche marketplaces, FAHGT consistently delivers superior performance compared to existing baselines, offering a promising avenue for enhancing trust and reliability in online review systems. Overall, the results and discussion section provides

ISSN 2347–3657

Volume 12 , Issue 2, April 2024

compelling evidence of the efficacy and superiority of FAHGT in detecting fraudulent activities in online product reviews using heterogeneous graphs. By addressing the challenges posed by camouflage fraudster behavior and the heterogeneous nature of inconsistency in a unified manner, FAHGT offers a robust and effective framework for safeguarding the integrity of online review platforms and enhancing trust and reliability for consumers and enterprises alike.

CONCLUSION

In this paper, we propose FAHGT, a novel heterogeneous graph neural network for fraudulent user detection in online review systems. To handle inconsistent features, we adopt heterogeneous mutual attention for automatic meta path construction. To detect camouflage behaviours, we design the label aware scoring to filter noisy neighbours. Two neural modules are combined in a unified manner called “score head mechanism” and both contribute to edge weight computation in final feature aggregation. Experiment results on real-world business datasets validate the excellent effect on fraud detection of FAHGT. The hyper-parameter sensitivity and visual analysis further show the stability and efficiency of our model. In summary, FAHGT is capable of alleviating inconsistency and discover camouflage and thus achieves state-of-art performance in most scenarios. By using efficient algorithms in this project and by using heterogeneous graph technique models we detect that the user given review either fraud or not fraud. In the future, we plan to extend our model in handing dynamic graphs data and incorporate fraud detection into other areas, such as robust item recommendation in E-commerce or loan default prediction in financial services.

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