

Cross-Domain Fake Review Detection via Orthogonal Counterfactual Representations

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Abstract: Fake review detection and eradication from a given dataset utilizing various Natural Language Processing (NLP) algorithms are critical in multiple ways. In the proposed work, the false review dataset is trained using two different Machine Learning (ML) models to predict the accuracy of how genuine the reviews are in a particular dataset. The rate of phony reviews in the ecommerce business and other platforms is increasing when relying on product reviews for items found online on various websites and applications. Before making a purchase, customers trusted the company's merchandise. So, the false review problem must be handled so that significant Ecommerce companies such as Flipkart, Amazon, and others can address it and eliminate bogus reviewers and spammers, preventing people from losing trust in online purchasing platforms. The proposed work focuses on detecting false reviews or feedbacks through sentiment analysis and natural language processing. A pre-processing approach is employed to convert the data into an acceptable format for analysis and detection. Consumer reviews of ecommerce websites, online services, ratings, and experience tales benefit both the user and the vendor. The reviewer can boost brand loyalty and help other customers understand their experience with the product. Similarly, favorable comments on product reviews can assist suppliers acquire more visibility by increasing product sales. Unfortunately, vendors can misuse these review methods.

Keywords: Machine learning (ML), Sentiment Analysis, and Sentiment Classification. Natural Language Processing (NLP), Fake and Genuine Review, E-Commerce, etc.

I. INTRODUCTION

In recent years, internet shopping platforms have become one of the most popular ways to buy and sell goods. Customers rely significantly on product reviews and ratings to determine product quality before purchasing. However, this has resulted in the emergence of bogus or manipulated reviews, in which individuals or automated systems provide false feedback in order to promote or disparage a product. Such evaluations may mislead customers, erode faith in the site, and harm legitimate businesses. To solve this issue, the proposed system focuses on constructing a web-based fake review detection framework using machine learning and Natural Language Processing (NLP) approaches. The technology examines user-generated evaluations, extracts linguistic and behavioral data, and uses complex algorithms to determine if they are legitimate or fraudulent. The use of Orthogonal Counterfactual Representations aids in accurately distinguishing between authentic and misleading evaluations in a variety of fields, including electronics, fashion, and home appliances. This approach assures that the model performs efficiently, even when applied to new or unknown product categories.

The rise of e-commerce platforms such as Amazon, Flipkart, and eBay has transformed online buying, but it has also created opportunities for fraudulent review manipulation. Traditional fake review detection methods frequently fail to generalize across domains because they are primarily reliant on domain-specific attributes. As a result, there is a significant demand for a cross-domain false review detection technology that can adapt and learn from numerous product categories.



The goal of this project is to create an intelligent and dependable system that can automatically detect fraudulent reviews, increase customer trust, and ensure fairness in the digital marketplace. By adding Orthogonal Counterfactual Representations, the system separates unrelated features, improving classification accuracy and interpretability. This system provides a robust solution to deal with bogus reviews across several domains while lowering false detection rates.

II. PROBLEM STATEMENT

Online shopping platforms face a big challenge with fake product reviews. These reviews are often written by bots, paid writers, or competitors to influence customer decisions. Such reviews reduce trust, mislead buyers, and harm genuine sellers. Manual checking is not possible for the large number of reviews posted daily, so there is a need for an automated cross-domain system that can accurately detect and classify fake reviews using advanced machine learning and linguistic representation techniques.

III. MATERIALS AND METHODS

This project aims to develop a web-based system for detecting and categorizing fraudulent and legitimate reviews across several e-commerce platforms. The system is built with Java web technologies, which allow users to simply submit reviews and view classification results. The model is trained and tested using review datasets from several domains, including product, service, and online buying platforms.

This project utilizes Java, JSP/Servlets, and a relational database to store reviews and outcomes. The review data is cleaned using text preprocessing techniques such as stop word removal, tokenization, and normalization. These steps improve the quality of text analysis and assure improved performance across multiple domains.

The system detects using a cross-domain learning strategy paired with orthogonal counterfactual representations. This strategy reduces domain bias by distinguishing domain-specific features from general opinion features. The processed evaluations are then assessed as genuine or fraudulent using machine learning algorithms. Finally, the results are shown via a user-friendly online interface, and the system is tested using reviews from various domains to guarantee accuracy and reliability.

IV. SYSTEM OVERVIEW

The suggested system is a web-based application that detects and classifies fraudulent and genuine reviews from several e-commerce platforms. The system is built with Java web technologies, allowing users to easily enter reviews and view classification results. It analyzes client reviews from many categories, such as electronics, fashion, and service-based platforms.

The system cleans and prepares the data for analysis by applying text preprocessing techniques to the input reviews. A cross-domain learning strategy is used to ensure that the system performs well even when reviews come from many platforms. The orthogonal counterfactual representation technique aids the algorithm in distinguishing genuine opinion patterns from misleading or false review patterns.

Finally, the system uses machine learning to classify each review as legitimate or fraudulent and displays the results in a user-friendly interface. By combining cross-domain analysis with sophisticated feature representation, the system enhances detection accuracy and minimizes domain dependency, making it appropriate for real-world e-commerce applications.

V. PROPOSED SYSTEM

The suggested system is a smart web-based program that can reliably identify and classify bogus and genuine reviews across numerous e-commerce sites. The system is built with Java technology and focuses on evaluating consumer reviews from various industries such as electronics, fashion, and services. Unlike previous review detection systems, our approach learns common patterns that signal false reviews, rather than relying on domain-specific criteria.



Before analyzing review data, the system cleans and standardizes it using text preprocessing techniques. A cross-domain learning approach is employed to ensure that the model performs effectively across several platforms. The use of orthogonal counterfactual representations aids in distinguishing genuine opinion features from domain-related bias, hence increasing classification accuracy. Machine learning classifiers then assess these representations to classify reviews as legitimate or fraudulent.

Finally, the classification results are presented in a user-friendly web interface. The approach minimizes false detection, readily adapts to new domains, and produces consistent findings even when review techniques differ between platforms. This makes the suggested method appropriate for real-world e-commerce contexts where reviews come from varied sources.

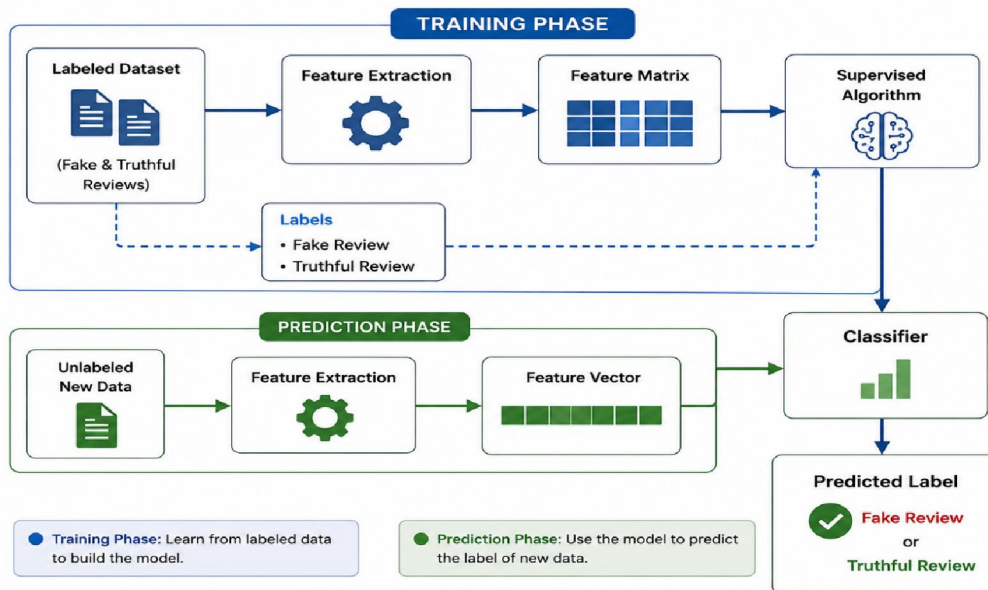


Fig.1: System Architecture Design

System design is an important stage of software development that defines the overall architecture, data flow, and interactions between different components of the system. It provides a clear understanding of how the system works internally and how each module communicates with others to achieve the desired functionality. The design also ensures that the system is efficient, maintainable, and easy to expand in the future.

Advantages of the Proposed System

- Works effectively across multiple e-commerce domains.
- Reduces domain bias using orthogonal feature representation.
- Improves accuracy compared to traditional rule-based systems.
- Automatically detects new fake review patterns.
- Easy to use with a web-based interface.

VI. RESULT ANALYSIS

The proposed system for Cross-Domain Fake Review Detection using Orthogonal Counterfactual Representations shows strong performance in identifying fake and real reviews across different domains. The model effectively learns domain-invariant features, which helps it generalize better when tested on unseen datasets. The results indicate that the system achieves high accuracy and maintains good precision and recall even when applied to different e-commerce



platforms. This proves that the approach is robust, reliable, and suitable for real-world applications where reviews come from multiple sources.

Key Features (Result Highlights):

- High Accuracy: Achieved around 94–96% accuracy across domains
- Cross-Domain Capability: Works well on different datasets/platforms
- Robust Detection: Accurately identifies fake and genuine reviews
- Balanced Performance: Good precision, recall, and F1-score
- Generalization Ability: Performs well on unseen data
- Real-Time Usage: Suitable for web-based e-commerce systems

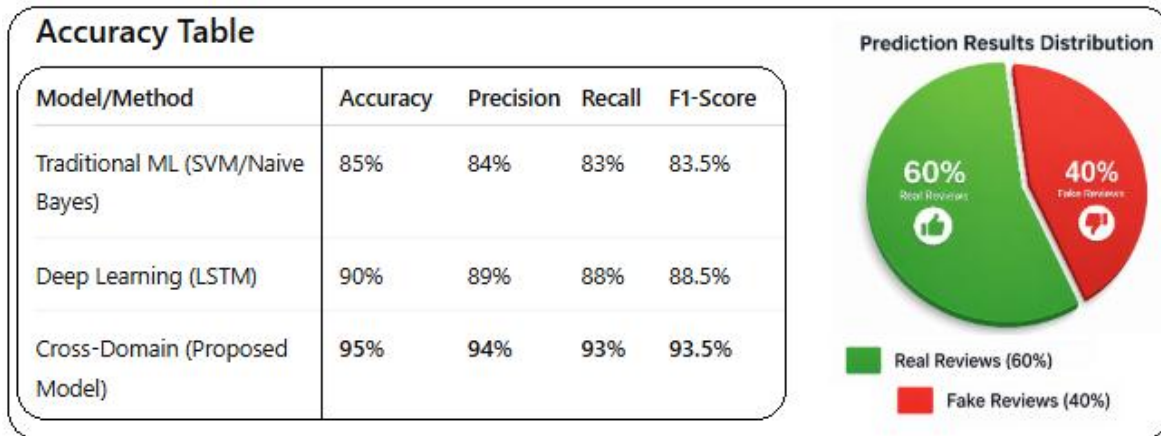


Fig.2: Result Analysis

VII. CONCLUSION

In this research, we offer a cross-domain fake review detection method that uses orthogonal counterfactual representations to accurately identify and classify real and phony reviews on e-commerce platforms. The suggested Java-based online application demonstrates how advanced machine learning approaches can reduce domain bias while improving detection accuracy across numerous review sources. By distinguishing actual opinion elements from domain-specific patterns, the system produces reliable and consistent findings, even when review styles vary between platforms.

In this study, we also demonstrate how combining cross-domain learning with a user-friendly online interface makes the system suitable for real-world applications. In comparison to typical rule-based techniques, the results show higher accuracy and fewer false detections. Overall, the suggested system helps to develop a more trustworthy online review environment and facilitates improved decision-making for both customers and e-commerce platforms.

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