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TRUST MODEL FOR E-COMMERCE WEBSITE

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Abstract: Trust on a product is the consumer's confidence and belief in the quality, reliability, and performance of a particular item. In today's digital landscape, establishing and maintaining customer trust is paramount for the success of online businesses, making e-commerce trust an essential factor. As we delve into the realm of e-commerce, it becomes evident that understanding this area requires a comprehensive grasp of the dynamics of trust. However, there is a need to look deeper into the factors that influence customer trust in e-commerce platforms. This paper aims to investigate and analyse the various factors that contribute to customer trust in e-commerce.

Keywords: E-Commerce, dataset, Recommendation System

I. INTRODUCTION

A trust model is a comprehensive framework that incorporates various factors to establish and enhance trust between users and e-commerce platforms. It encompasses mechanisms, policies, and features designed to instil confidence, credibility, and reliability in the minds of users.

In today's digital age, E-Commerce has revolutionized business and trade, with millions of customers engaging in online transactions worldwide. However, E-Commerce customers encounter challenges such as security concerns, trustworthiness of sellers, product quality uncertainties, and delivery issues. Despite these challenges, customers are driven to make purchases based on factors like competitive pricing, convenience, product reviews, and brand reputation. Trust is a critical aspect of successful E-Commerce transactions, established through security measures, transparency, customer reviews, and reliable support.

There are several key motivations for building a trust model in an e-commerce website. These motivations primarily revolve around creating a secure and reliable environment for customers.

Building a trust model in an e-commerce website is crucial for creating a secure, reliable, and transparent environment that instils confidence in customers, mitigates risks, and fosters long-term relationships. By prioritizing trust, e-commerce platforms can differentiate themselves, build their reputation, and ultimately drive growth and success in the competitive online marketplace.

This paper aims to find out how a customer can trust the product which is available on an online e-commerce website by analysing others' reviews and ratings. The proposed work provides a site that can establish credibility, increase customer confidence, mitigate the risks, stand unique from competitors, strengthen the brand reputation, and support growth and expansion.

By providing customers with a trust score, they can make informed judgments and decisions about whether to choose a specific product or explore alternative options. To generate this trust score, customer data on product reviews was collected, which included comprehensive information about the product, details about the reviewers, ratings assigned, and sentiment analysis of the review text. Through careful analysis of these factors, a trust score was calculated, enabling customers to assess the reliability and credibility of the product. This information empowers customers to make well-informed choices that align with their preferences and needs.

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For result analysis verified_purchase, review_rating, review text ,review title will be of more contribution. So we considered them as hypothesis factors in our implementation. And also the threshold of the final trust score for consideration of purchase in recommendation system is considered as 30%. If the threshold is greater than 30% it'll indicate that the product is trustable otherwise not.

The paper is organized as follows, section II discusses our contribution on paper, section III talks about literature survey. Section IV shows the methodology of project implementation. Section V shows the results and section VI concludes the paper.

II. OUR CONTRIBUTION

The most important factor in determining the success or failure of e-commerce is trust. At the time of purchase of goods or services online, consumers are concerned about unsafe items, unreliable payment methods, lack of privacy, and abuse of personal information. If an e-commerce store's website is perceived as not trustworthy, customers are less likely to buy from any site.

By identifying and analysing these factors and their impact on customer trust, We aim to provide valuable insights for businesses to enhance their strategies and build stronger relationships with their online customers. The primary problem to be addressed is to investigate the various factors contributing to customer trust in e-commerce, identify key determinants, and develop effective measures to cultivate and maintain trust. Ultimately, the project will deliver a trust scoring system that can assess the trustworthiness of e-commerce websites, assisting both businesses and consumers in making informed decisions in the online marketplace.

III. LITERATURE SURVEY

In this section study of previous work has been discussed

Sonja Grabner-Kräuter, A.E. Kaluscha[1] in their study focuses on consumer trust in the context of electronic commerce (e-commerce). They provide a conceptualization of consumer trust and classify trust-building measures. The authors emphasize the significance of consumer trust in driving successful e-commerce transactions and discuss factors that influence trust, such as website design, security measures, reputation, and customer reviews. They propose a conceptual framework and categorize trust-building measures into information-based, reputation-based, assurance-based, and relationship-based groups, offering specific strategies within each category to enhance consumer trust in e-commerce. Overall, the paper contributes to understanding and improving consumer trust in e-commerce settings.

Liaoliang Jiang, Yuting Cheng,Li Yang, Jing Li[2] in their study they focus on trust-based collaborative filtering algorithms for E-commerce recommendation systems. By combining trust-based techniques with collaborative filtering, the algorithm considers the trustworthiness of users and their interactions to generate more accurate and effective recommendations. The paper highlights the importance of trust in E-commerce environments and addresses limitations of traditional collaborative filtering algorithms. Through experimental evaluation, the authors demonstrate the effectiveness of their algorithm in providing reliable and relevant recommendations, contributing to the advancement of E-commerce recommendation systems.

Paul A. Pavlou[3] in his study about consumer trust in electronic commerce, provided a synopsis of different conceptualizations of trust and analysed the adequacy of these different perspectives in order to conceptualize and define online trust. The authors proposed a set of trust constructs that facilitates a multi-level and multi-dimensional analysis of e-commerce trust. The analysis suggests that the willingness of online consumers to use the Internet for economic transactions and even more actual risk-taking behavior require both system trust and transactional trust.

Camilo Alejandro Valencia-Martinez1 , Paulo Alonso Gaona-García1, Carlos Enrique Montenegro-Marin1[4] present a trust system designed specifically for e-commerce platforms using linked open datasets. The proposed system incorporates quality dimensions to assess the trustworthiness of platforms operating in a linked open data environment. The authors analyse and discuss various quality dimensions such as data accuracy, completeness, timeliness, provenance, and reputation. The paper contributes to enhancing the credibility and reliability of e-commerce transactions by evaluating the quality of linked open datasets and providing a trustworthiness scoring mechanism.

Saeedeh Shekarpour, Seraj Katebi[6] in their study focuses on modeling and evaluating trust in the context of the semantic web. They propose an extension to the semantic web that incorporates trust modeling, considering factors like reputation

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and credibility. The paper provides a detailed analysis of their trust model and offers insights into evaluating trustworthiness, addressing challenges and practical implementation. Overall, it contributes to the field of semantic web by presenting a comprehensive approach to incorporating trust in web-based interactions.

Eng Chin Ooi,Chu Yee Liau,Lee T Tan[6] in their study they focus on managing trust in peer-to-peer (P2P) systems using reputation-based techniques. The authors address the challenges of trust in P2P environments where there is a lack of centralized authority. They propose a reputation-based approach to assess the trustworthiness of peers and present a framework for managing trust through reputation systems. The paper provides insights into the implementation and evaluation of their approach, highlighting its effectiveness in enhancing trust and reliability in P2P systems.

Bo Li, Peng Qi, Bo Liu, Shuai Di, Jingen Liu, Jiquan Pei, Jinfeng Yi, Bowen Zhou[7] in their study focuses on the concept of building trustworthy AI systems. The authors propose a framework that translates trust principles into practical implementation practices, addressing challenges like bias, privacy concerns, and lack of transparency in AI. They provide a set of principles, including fairness, accountability, transparency, privacy, reliability, and robustness, and discuss practical techniques such as explainable AI and algorithmic fairness to incorporate these principles. The paper emphasizes the need for multidisciplinary collaboration and regulatory frameworks to ensure the development of trustworthy AI and discusses its implications in various domains.

Yonghong Wang,Chung-Wei Hang,Munindar P. Singh[8] proposes a probabilistic approach for maintaining trust based on evidence. They introduce a framework that utilizes Bayesian reasoning to assess and update trust levels between entities, considering factors like direct observations and historical interactions. The approach offers benefits such as handling incomplete or conflicting evidence and adapting to changing circumstances. Overall, the paper presents a valuable contribution in the domain of trust management, providing a practical and adaptable approach for maintaining trust in various contexts.

Chung-Wei Hang and Munindar P. Singh[9] introduced a trust-based recommendation method that utilizes graph similarity. The approach analyses trust relationships among users to determine similarity and generate personalized recommendations. By incorporating trust, the algorithm improves recommendation accuracy and provides relevant suggestions based on user preferences and trust patterns. The paper emphasizes the importance of trust in recommendation systems and presents experimental results to showcase the effectiveness of the proposed approach.

Christopher J. Hazard and Munindar P. Singh[10] introduces an architectural framework that combines trust and reputation in computational systems. The approach emphasizes the importance of considering both trust and reputation as separate but interrelated concepts, with trust representing subjective expectations and reputation reflecting collective opinions. The paper elaborates on the design principles and components of the proposed architecture, highlighting its potential for improved decision-making in various domains. Overall, it provides a valuable contribution to the field by offering a unified framework for managing trust and reputation in distributed systems.

Yonghong Wang and Munindar P. Singh[11] presents a formal trust model designed to enhance trustworthiness in multiagent systems. The model combines subjective and objective trust factors, considering both direct and indirect trust relationships between agents. By formalizing trust, the authors provide a foundation for designing and analysing trust-based interactions in complex multiagent systems. This model has significant implications for improving the reliability and security of interactions among agents in various domains.

Christy M.K. Cheung ,Matthew K.O. Lee[12] presents an integrative model of consumer trust in internet shopping. The model incorporates multiple factors that contribute to the formation of trust, such as website quality, vendor reputation, security and privacy concerns, customer support, and social influence. Through empirical research, the authors validate the model and provide insights into the relative importance of these factors in influencing consumer trust. The findings have significant implications for online retailers and marketers, enabling them to develop strategies to enhance trust and improve the online shopping experience.

Priya Govindraj[13] in their study focuses on examining different trust models used in cloud computing and emphasizes their importance in ensuring secure and reliable cloud services. The paper provides a comprehensive review of trust models, discussing their underlying principles, evaluation techniques, strengths, and weaknesses. It also explores the application of these models in various cloud computing scenarios, aiding researchers and practitioners in selecting and designing suitable trust models to enhance the security and reliability of cloud services.

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Elvin Eziama, Saneeha Ahmed, Sabbir Ahmed, Faroq Awin, Kemal Tepe[14] present a novel approach for detecting adversary nodes in machine-to-machine (M2M) communication networks. They propose a machine learning-based trust model that utilizes historical data and behavioural patterns to classify nodes as trusted or adversarial. The approach achieves high detection accuracy while maintaining a low false positive rate, enhancing the security of M2M communication networks. The experimental results validate the effectiveness of the proposed approach in reliably identifying adversary nodes and ensuring trustworthy data transmission in M2M networks.

Francisco Moyano, Carmen Fernandez-Gago, Javier Lopez[15] introduce a conceptual framework for understanding trust in different contexts. It considers four dimensions: trustor, trustee, context, and trust itself, to provide a structured approach to analysing trust and its formation. The framework emphasizes the multidimensional nature of trust and its interplay with risk, decision-making, and related concepts, contributing to a deeper theoretical understanding of trust and its practical applications.

IV. METHODOLOGY

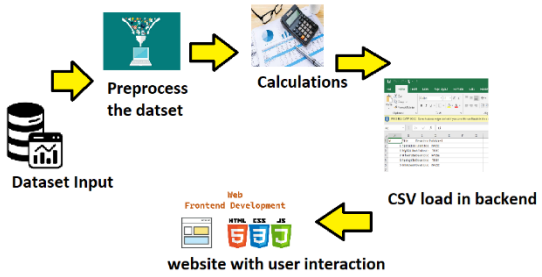

Fig.1 System Architecture

The Fig.1 explains the system architecture. The steps included are dataset input, preprocessing, calculations, csv loading and finally interacting with the website.

Dataset:

Fig.2 Original Dataset

Fig. 2 illustrates the original dataset used, the "Amazon UK shoes products dataset" which includes columns like URL, product name, reviewer name, review title, review text, review rating, verified purchase, review date, helpful count, unique ID, and scraped date.

Pre-processing:

In Pre-processing, null values and irrelevant fields are removed from the dataset. This task is accomplished by utilizing the powerful data manipulation capabilities of libraries such as Pandas, scikit-learn, and NumPy. Additionally, during the dataset insertion phase, the counts of Nan values in each column are carefully evaluated to ensure data integrity. The scikit-learn Label Encoder is used to treat categorical columns by converting the strings to numbers and Min-Max Scaler is used for data normalization. The text data is cleaned by eliminating special characters, converting it to lowercase, and using text normalization techniques such as stemming or lemmatization.

The Fig.3 is the dataset obtained after preprocessing.

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Fig.3 Dataset after processing

Method:

To compute the trust score, devised a formula that took into account the previously described elements. This algorithm takes the verified purchase status, review rating, review text sentiment, and review title sentiment into consideration. The trust score for each review was calculated by multiplying each component by its appropriate weight and aggregated mean for the same product. The estimated trust ratings, together with the related product names are saved in a CSV file or another suitable data format for simple access and retrieval.

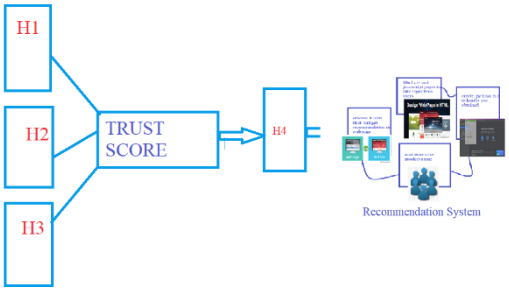

Fig.4 Hypothesis Considered

The Fig.4 is about the hypothesis considered in this study. They are:
H1: Verified purchase is positively related to the trust score value.
H2: Review rating is directly related to the trust score.
H3: Review title and text sentiment helps in increasing the trust.
H4: If the trust score is greater than 30%, then only it is considered trustworthy.
Design a user interface utilizing HTML, CSS, and JavaScript for the frontend setup. This interface allowed users to enter a product name and obtain the trust score for it. Used Flask as the backend, a Python web framework, to put up the server that would process user requests and deliver the trust scores based on the product name supplied. Load the CSV file with the trust ratings and product names into memory or an appropriate data structure into the Flask backend.

Create an API endpoint in Flask to allow communication between the frontend and backend. This endpoint took the product name as input and returned the trust score from the loaded data. In the frontend, we used JavaScript to submit an HTTP request to the Flask API endpoint with the supplied product name. We received the trust score answer and presented it on the frontend user interface. Customize the frontend interface using HTML and CSS, creating and styling it properly, to improve the user experience. Finally, launched the application by launching the Flask server and the frontend. Extensively tested the application by inputting several product names and ensured that the trust score was shown accurately for each one.

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Fig.5 Recommendation System

The Fig.5 explains the recommendation system module. Users are prompted to enter a product name on the website. After submission, they are redirected to a new page displaying the product's trust score and a purchasing suggestion. This integration of technologies enables a seamless user experience and facilitates informed decision-making for potential customers.

Formulae:

Sentiment analysis function:

```
def get_sentiment_polarity(text):
    if isinstance(text, str):
        blob = TextBlob(text)
        return blob.sentiment.polarity
    else:
        return 0.0
```

Calculated the trust score using these notations for each parameter:
Verified Purchase: VP
Weight of Verified Purchase: WVP
Review Rating: RR
Weight of Review Rating: WRR
Review Text Sentiment: RTS
Weight of Review Text Sentiment: WRTS
Title Sentiment: TS
Weight of Title Sentiment: WTS
The formula for the trust score can be written as:
Trust Score = (VP * WVP) + (RR * WRR) + (RTS * WRTS) + (TS * WTS)

group-by function to handle multiple reviews of the same product :

```
amazon_trust=
amazon.groupby('product_name').agg({'review_rating':'mean','verified_purchase':'mean','text_sentiment':'mean','title_sentiment':'mean','trust_score':'mean'}).reset_index()
```

It is taken as a new column to the csv file.

Note: Weights are assumed as per the importance given to the parameters.

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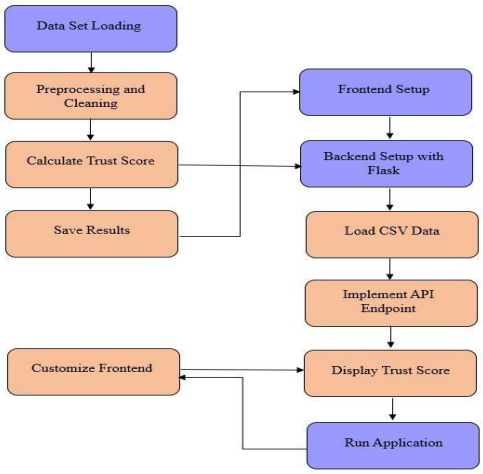

Fig.6 Detailed Design

The Fig.6 shows the detailed sequence diagram of the whole system.

V. RESULTS

The integration of Flask and the trust score model enables a seamless user experience, allowing potential customers to obtain valuable information about product trustworthiness. Upon submitting the product name, Flask retrieves the corresponding trust score from the CSV table and dynamically generates a new webpage. The new page displays the product's trust score along with a purchasing suggestion, which is determined based on predefined thresholds or rules derived from the trust score.

By providing a trust score and purchasing suggestion, users can make more informed decisions, fostering consumer confidence and enhancing overall satisfaction. The approach has been evaluated through user testing, and positive feedback has been received regarding the ease of use and relevance of the provided information

Fig 7. and fig 8. shows the example where customer can trust the product:

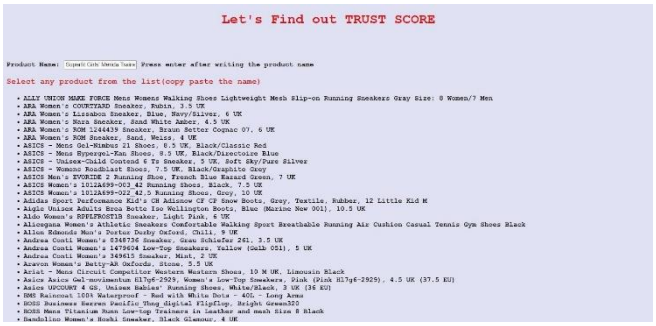

Fig.7 Entering the product name(example 1)

Fig.8 Redirected page (example 1)

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Fig 9. and fig 10. shows the example where customer can not trust the product:

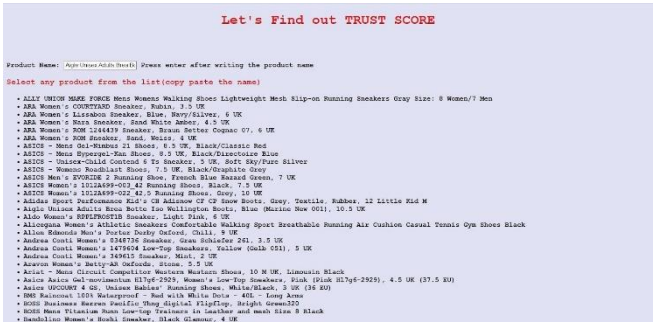

Fig.9 Entering the product name(example 2)

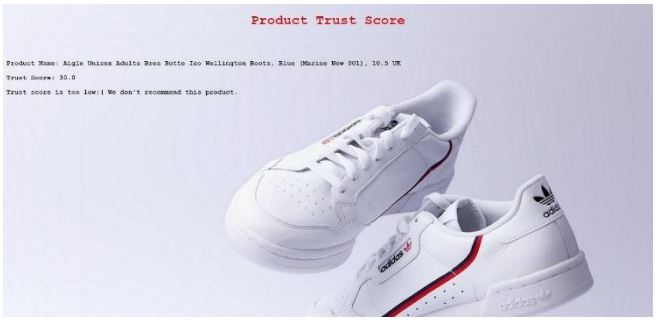

Fig.10 Redirected page (example 2)

VI. CONCLUSION

This research paper presents a novel integration of Flask and a CSV-based trust score model, designed to enhance the user experience and facilitate informed decision-making for potential customers. The seamless interaction between Flask and the trust score model empowers users to obtain valuable insights and recommendations regarding product trustworthiness.

While the current implementation hasn't been used practically yet,before executing it there is a room for future research and improvement. One avenue for exploration involves incorporating additional features into the trust score model, considering factors such as product specifications, brand reputation, and customer feedback from multiple sources. Refinement of the trust score model's algorithms and statistical techniques can also enhance its accuracy and reliability, further boosting the trustworthiness of the generated scores.

The integration of Flask and the CSV-based trust score model offers a seamless user experience and empowers potential customers to make informed decisions. By providing transparent trust scores and purchasing suggestions, this approach addresses the information gap that often exists in the decision-making process. The results of this research have significant implications for both consumers and businesses, enabling more confident and satisfying purchasing experiences.

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