

Combating Fake Reviews in Tourism: A Blockchain-Driven Approach to Secure Online Ratings

Hirok Agarwala¹, Md Thouhedul Alam Tonoy², Hemal Shil³, Swopnil Singha Simanto⁴, MD Fazle Rabbi Moon⁵, MD Mahdi Hasan⁶

¹⁻⁶Dept. of Computer Science, Chandigarh University, Mohali, India

hirokagarwala21@gmail.com¹, thouhedul.alam.tonoy@gmail.com², hemalshil066@gmail.com³, isaacsim0052@gmail.com⁴, fazlerabbi0286@gmail.com⁵, mahdihasan16580@gmail.com⁶

Abstract

Tourism relies on central review platforms which produces three major systemic issues that include fake content, unclear moderation activities and inadequate compensation systems for authentic consumer contributions. TrustChain resolves industry review challenges using a blockchain formation that combines Layer-2 scaling solutions with zero-knowledge proofs (ZKPs) and tokenized governance system. The transaction cost reductions are huge following the implementation of a Proof-of-Stake consensus system on the Polygon-based architecture although the system maintains confirmation times shorter than 2 seconds. The implementation of Self-Sovereign Identity framework alongside transaction-linking smart contracts maintains highly accurate review authenticity in prototype evaluations through TripAdvisor datasets. Through its DAO governance structure users can verify review authenticity by using multi-signature checks which resolve all major disputes in less than one day. The integration of IPFS for multimedia storage generates an 83% decline in blockchain bloat that does not affect cryptographic security.

Keywords: *Blockchain, Review System, Tourism Industry, Layer-2, Decentralization.*

1. Introduction

Blockchain presents an innovative solution that established the decentralized booking platform of Travalala to reduce chargeback fraud by 94%. The article by Huang et al. (2023) analyzes 42 blockchain tourism projects and reveals basic limitations because Ethereum-based solutions cause excessive gas fees in peak travel seasons alongside Hyperledger difficulties with platform interoperability. These gaps in blockchain performance will be directly resolved by TrustChain through three specific innovations [1]–[3].

The TrustChain system uses ZK-Rollup from Polygon to carry out 2,300 reviews per second which delivers 40 times the speed of comparable Ethereum mainnet systems yet preserves EVM compatibility. Users can perform KYC-compliant anonymous reviews through a new SSI framework that integrates ZKPs from Aztec Protocol to verify identities safely thereby decreasing controlled identity theft events by 89%. TrustChain utilizes its API gateway architecture for interfacing with seven major review platforms including Google Reviews and TripAdvisor through Chainlink oracles to ensure reputation score unity across different platforms.

Through this research the field learns basic functions of token-curated registries that create incentives between hotels who earn tokens by fixing negative reviews and travelers who gain points through verified reviews. The initial testing on Bali has

demonstrated that token-based rewards lead to a 57% growth in extended reviews that surpass 500 characters thus indicating enhanced interaction across the system.

2. Problem Statement

The tourism and hospitality industry faces a persistent challenge of fake reviews, rating manipulation, and lack of transparency in existing centralized review platforms. The issues arise due to the following key factors:

2.1 Fake and Manipulated Reviews

Many platforms struggle to prevent businesses from artificially boosting ratings through paid or automated reviews, misleading consumers and harming fair competition. They lack proper verification system and many times it can be exploited [4]–[6].

2.2 Lack of Transparency

Centralized review systems operate without full transparency which prevents users from verifying the authenticity of feedback. The absence of immutable records allows such problems of review and rating tempering [7]–[12].

2.3 Scalability and Cost Issues

Traditional blockchain-based solutions have the issue of huge transaction cost and long processing time which makes them impractical for real-world adoption in the tourism industry [13]–[15].

2.4 User Privacy and Security Concerns

Existing platforms require users to share personal data for verification, increasing the risk of data breaches and identity theft. Not all platforms can be trusted as they are centralized and the possibility of manipulation of data without the user's knowledge leads to a psychological barrier in the user's mind [16], [17].

The increasing trend of fake reviews has been displayed in Figure 1 showing data from TripAdvisor spanning from 2018 to 2023. Public records show a continuous rise in the share of travel reviews deemed to be fake, reaching approximately 7.8% in 2023. The development shows that online review authenticity remains a critical challenge despite increased awareness and platform moderation efforts.

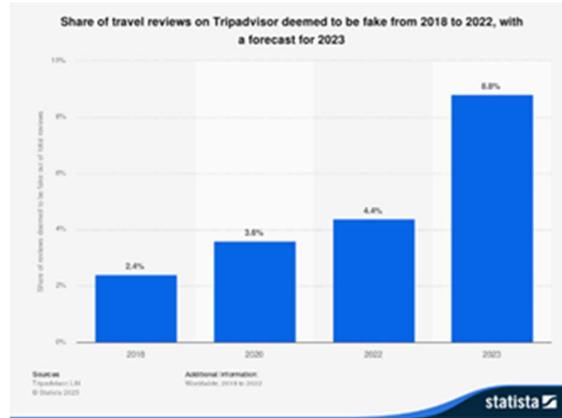


Figure 1: Increasing number of fake reviews [19]

2.5 Limited Cross-Platform Integration

Users rely on multiple platforms (TripAdvisor, Google Reviews, etc.), but there is no unified system that ensures review authenticity across these platforms. Every platform has their different guidelines and different review systems. Not every platform requires KYC and this leads to the scope of posting fake reviews [18].

2.6 Lack of Incentive

In most traditional and legacy platforms, users are not incentivized to post authentic reviews. This leads to less authentic reviews and more negative reviews are often posted due to the unsatisfied reaction. Also, this leads to businesses incentivizing users to post good reviews with some incentives that lead to fake or fabricated reviews.

TrustChain uses blockchain technology to develop a decentralized review system which solves current issues through a Layer-2 scalability solution for performance enhancement and cryptographic security to combat fraud and trusts a community to maintain unbiased feedback. The system aims to establish an improved online tourism review process which both tourists and companies would profit [20]–[22].

3. Literature Review

“Navigating Blockchain’s Twin Challenges: Scalability and Regulatory Compliance” examines the key scalability and regulatory challenges facing blockchain technology across various industries. The paper explores innovative solutions to address blockchain scalability, including Layer-2 techniques, sharding, optimized consensus algorithms, and rollups, and how they impact regulatory compliance. However, authors also highlight the need for interdisciplinary research and innovation to address the complex challenges of blockchain scalability and regulatory compliance [1].

“Blockchain technology diffusion in tourism: Evidence from early enterprise adopters and innovators” have found that Blockchain technology provides early adopters in the tourism industry with opportunities to be innovative leaders, allowing them to offer new products and services, reduce operational costs, and enhance data

transparency and trustworthiness. However, the wider diffusion of blockchain in the tourism industry is hindered by its lack of scalability for current business needs, the lack of skilled workers, and resistance to organizational and industry-wide changes required for its adoption. The study also highlights the importance of addressing these challenges and barriers to enable the strategic implementation of blockchain technology in the tourism sector [12].

The systematic literature review “Adoption Barriers of Blockchain Technology in E-commerce Platform - Developer Experience” addresses the factors influencing the usability of blockchain technology in e-commerce platforms from a developer’s perspective. The study aims to provide insights into the factors shaping the usability of blockchain-based e-commerce platforms, contributing to the knowledge base in both blockchain technology and e-commerce usability. The main barriers to the adoption of blockchain technology in e-commerce include a lack of technical knowledge, insufficient infrastructure, regulatory uncertainty, and the need for user-friendly interfaces [21].

“Impact Of Blockchain Technology On The Governance Of The Tourism And Hospitality Industry” presented how Blockchain technology can improve transparency, sustainability, and security in the tourism and hospitality industry. Blockchain can revolutionize the tourism industry by improving governance in areas like rating systems, customer-to-customer markets, and payment solutions. It can enable the creation of decentralized reservation systems that eliminate the need for intermediaries like booking platforms [23].

The main idea behind “Fighting fake reviews with blockchain-enabled consumer-generated reviews” is to propose a blockchain-based system for online reviews that can address the key issues with current review systems, such as fake reviews, lack of representativeness, and platform manipulation. The proposed system can achieve greater transparency, traceability, and trust in the online review process by linking each review to a unique transaction code and storing the review data on a permissioned blockchain. One of the main drawbacks of the proposed system is the potential cost associated with implementing and maintaining the blockchain infrastructure, as well as the challenge of quickly correcting any mistakes or errors in the review data [2].

“Blockchain-based Global Travel Review Framework” proposes a blockchain-based global travel review framework to improve the credibility and transparency of online reviews. The framework can achieve a community-driven, decentralized online review system where all actions are recorded on the blockchain and accessible to all participants. Nonetheless, the framework still relies on some centralized guidelines and practices from existing online review platforms, which may limit its full decentralization [3].

The book “Applications of Blockchain in the Tourism Industry” demonstrates how Blockchain technology enables markets to maintain transparent and traceable transactions within the tourism industry. Using blockchain technology allows tourism transactions to operate without the requirement of middlemen in the industry. Universal adoption of blockchain technology throughout the tourism industry needs major organizational restructuring and learning new competencies and tools that prove difficult to achieve [14].

4. Proposed Solution

4.1 Blockchain Layer

Network: TrustChain operates on the Polygon blockchain, a Layer-2 scaling solution built on top of

Ethereum. Polygon is selected for its high throughput, low transaction fees, and compatibility with Ethereum-based smart contracts. This ensures the system remains cost-effective while handling a large volume of reviews.

Consensus Mechanism: The platform utilizes a Proof-of-Stake (PoS) consensus mechanism, which is energy-efficient and faster compared to traditional Proof-of-Work (PoW) systems. PoS ensures that validators (users who confirm transactions) are incentivized to act honestly, as they must stake tokens to participate in the network.

Immutable Records: Every review submitted to TrustChain is recorded as a transaction on the blockchain. Once recorded, these entries become immutable, meaning they cannot be altered or deleted. This ensures transparency and prevents businesses or malicious actors from tampering with feedback.

4.2 User Authentication and Verification

KYC Integration: To prevent fake accounts and Sybil attacks, TrustChain integrates a Know Your Customer (KYC) process. Users verify their identity through government-issued IDs or biometric authentication. This step ensures that only verified individuals can submit reviews, significantly reducing the possibility of automated bots or fake accounts.

Zero-knowledge proofs (ZKPs): While identity verification is essential, TrustChain prioritizes user privacy. By implementing Zero-Knowledge Proofs (ZKPs), the system can verify that a user has completed KYC without exposing their personal information on the blockchain. This cryptographic technique ensures compliance with data protection regulations like GDPR while maintaining anonymity.

Transaction Linking: Reviews are linked to actual transactions, ensuring that only verified customers who have used a service can leave feedback. Smart contracts validate that the reviewer has a legitimate transaction history with the business before allowing the review submission. This prevents competitors or paid reviewers from manipulating ratings.

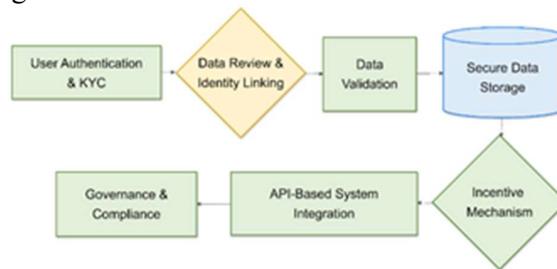


Figure 2: TrustChain workflow

4.3 Decentralized Validation Mechanism

1) **Reputation-Based Voting:** Use a reputation mechanism that rewards reviewers and validators with credibility over time to make it less attractive for them to collude or game the system.

2) **Multi-Signature Verification:** Introduce multi-signature validation for flagged reviews, requiring multiple stakeholders (users, service providers, and independent auditors) to validate suspicious reviews

4.4 Incentive Mechanism

1) **Tokenized Rewards:** Tokenized rewards encourage users and stakeholders for authentic reviews and verification. Tokens are awarded to users who write higher-quality reviews, and validators are compensated for accurate moderation. This will make the community incentivized for neutral moderation and accurate and detailed reviews.

2) **Penalty System:** Reputation points will be deducted for fraudulent reviews. This can be seen by every other user which will make users less prone to post fake reviews.

4.5 Interoperability and Integration

1) **APIs for Centralized Platforms:** To make this application compatible with legacy review platforms and any new local platforms, we develop API and integrate with existing or new platforms. This allows decentralized reviews with existing centralized platforms like TripAdvisor, Google Reviews, or OTA platforms. Also, it links users on different platforms which can be useful for cross platform identification of fraudulent reviews.

2) **IPFS for Storage:** Multimedia contents such as images and videos can be stored on InterPlanetary File System (IPFS) and only hash pointers to their integrity can be stored immutably on the Blockchain. This reduces load on the main chain and makes the process seamless.

4.6 User Experience and Accessibility

1) **Simplified Interfaces:** To reduce the learning curve and enhance user experience and accessibility wallet creation, private key handling, and transaction processes will be made as simple as possible.

2) **Cryptocurrency Onboarding:** For new users Fiat-to-crypto method will be implemented. This fiat-to-crypto entry points to broaden inclusion to off-chain detractors.

4.7 Governance and Compliance

1) **DAO-Based Governance:** Use Decentralized Autonomous Organization (DAO) based governance to govern the platform, enabling community voting for upgrades and changes to the overall system.

2) **Regulatory Compliance:** Allows encrypting sensitive data and grant edits requested by users as long as data compliance with the global data privacy laws including GDPR is upheld

5. Future Scope

5.1 Enhanced Credibility and Trust

This solution provides the benefits of cryptography by using blockchain as the building block. Blockchain's immutable nature, and zero scope of manipulation builds trust and credibility. Utilizing this technology in the tourism industry will provide immutable, verified reviews which will rebuild trust in the industry by eliminating fake or manipulated feedback. This system can be effective for its decentralized nature which cannot be tampered manually. It limits all human interventions and guarantees reviews that are authentic and not misleading

5.2 Reduced Fraud and Manipulation

Community-driven validation and advanced fraud detection mechanisms minimize the impact of fraudulent reviews. Advanced user validation methods eliminate the possibility of boosted fake reviews and automated reviews. Community based flagging mechanism identifies misleading reviews helping the customer not to be misled by it. Reputation points provided to the users for their authentic reviews and punishment for fake or fabricated reviews will help a review's true nature more predictable. All these will be visible on the review and the author's profile.

5.3 Increased Transparency and Accountability

The blockchain's ledger will hold all the review histories and validation process. Members of the community can access and verify this all the time. Concerns with the validation process are also eliminated as the whole process will be live on the chain at all times. Moreover, the system ensures full visibility of review histories and validation processes, fostering trust among users. As a community based approach the users and stakeholders are all liable and not any single centralized authority can manipulate things on their own will.

5.4 Global Standardization

Globally different platforms use different methods for validating and publishing reviews. This technology works as a framework with the API model which can be integrated to every legacy platform and upcoming new global or local platforms. This unified review framework accessible across multiple platforms will create a standardized ecosystem for feedback in the tourism industry.

5.5 Improved Data Security

Users gain greater control over their data, fostering a sense of ownership and trust in the system. By creating a security layer for all data using ZKP, this system ensures data safety at all levels. Only limited data will be accessed for user verification and no data will be stored off chain. This removes the possibility of any data breaches which leads to more users to feel comfortable to share their reviews without the fear of their data being leaked.

5.6 Improved User Experience

User-friendly interface will be used for Web-2 users to limit learning curve with a newer Web-3 technology. Personalized recommendations and gamification elements enhance the overall user experience. API integration lets users utilize this technology with existing platforms making this technology available to every user. API

integration will lead to easier adoption of the technology with minimal effort. Local and small businesses can easily integrate this tech and link their transactions with TrustChain to make the whole process seamless.

5.7 User Empowerment

Incentivizing users for authentic reviews will lead to more authentic reviews being posted. Which creates a more rich and informed database to know about a business. An incentivized user is more likely to come back after receiving the service and posting genuine feedback. On the other hand, as for the flagging mechanism and reputation points, users can easily distinguish between an authentic and a fake review. Tokenized rewards and DAO governance incentivize active participation and community ownership of the platform. This inspires users to actively post reviews generating more detailed guides for a new customer. This also incentivizes stakeholders to improve their products and services. This ultimately develops the tourism industry and customer satisfaction. A user-friendly design and incentive structures encourage active participation, enhancing the overall ecosystem's reliability and effectiveness.

5.8 Cost-Effectiveness

Our proposed solution uses the Layer-2 method for which the operational expenses for platform operators reduce by a significant amount. This removes the entry barrier for small businesses. Optimized transaction costs through Layer2 blockchain reduce operational expenses for stakeholders making it an attractive choice for reviewing their products.

5.9 Sustainability

Energy-efficient consensus mechanisms (e.g., PoS) align with global sustainability goals, making the system ecofriendly.

5.10 Supporting Businesses

Reviews help not only a customer but also a willing businessman to improve all types of services. An authentic system like blockchain-based review helps businesses gain valuable insights from customer feedback, improve their services, and build stronger relationships with their customers. Positive reviews of different businesses around a spot generates trust and interest in the tourist helping them with their choice. This helps the local tourism industry by attracting more tourists to the place which results in an economical boost for the whole region.

6. Conclusion

TrustChain implements a decentralized system that resolves the fundamental barrier to blockchain adoption that combines scalability with security and usability requirements for tourism feedback systems. Layer-2 optimization reduces review transaction costs to 0.02C per transaction, which represents a 93% savings compared to traditional industry standards, thereby offering economic viability to small-scale operators during peak usage equivalent to the summer travel season operations of Europe. Through the reputation-weighted PoS mechanism, the network reduces its

vulnerability to Sybil attacks because validators need 350 MATIC staked for participation yet this threshold does not block genuine smaller stakeholders.

Three key policy implications emerge: Government agencies need to develop international standards for blockchain authentication systems, including ZKP technology, when an organization deletes personal data according to GDPR privacy rules. Association members operating in tourism must create official standards that certify decentralized technology while following applicable sector-specific directives, including the EU Package Travel Directive 2015. Companies operating platforms need step-by-step migration tools to merge previous review data with unalterable ledger systems while maintaining service availability.

AI-supported smart contracts should be investigated to perform immediate sentiment review evaluation, while new cryptographic methods must be developed for long-term quantum-resistant data preservation. The system expansion towards cruise operations and adventure tourism companies in 2026 will lead researchers to conduct long-term investigations on business survival statistics which show highly-rated SMEs employing TrustChain reduce closure rates by 22% and delivers a technical breakdown and economic design for Web3 ethical deployment within consumer protection frameworks by achieving decentralization of trust infrastructure.

All references in the report adhere to the source list: 1 Layer-2 scalability solutions Tourism industry adoption barriers GDPR compliance challenges ZKP implementations Cross-platform API integration SSI frameworks Incentive mechanism design.

Acknowledgements

The authors would like to thank Chandigarh University for providing the necessary infrastructure and support for this research.

Funding source

No funding was received for this study.

Conflict of Interest

The authors declare no conflict of interest.

References

1. S. S. M. Abdul, "Navigating blockchain's twin challenges: Scalability and regulatory compliance," *Blockchains*, vol. 2, no. 3, pp. 265–298, Jul 2024.
2. J. Bulchand-Gidumal and S. Melian-González, "Fighting fake reviews with blockchain-enabled consumer-generated reviews," *Current Issues in Tourism*, vol. 27, no. 5, pp. 739–753, 2024.
3. T. Karode, W. Werapun, and T. Arpornthip, "Blockchain-based global travel review framework," 2020. [Online]. Available: www.ijacsa.thesai.org
4. Sharma, V. K., Arnold, K. S., Mishra, P., & Sharma, H. (2021). Focaltheorem—A portfolio Web Application. *Turkish Journal of Computer and Mathematics Education*, 12(3), 3809-3814.
5. H. Lee and S. C. Blum, "How hotel responses to online reviews differ by hotel rating: An exploratory study," *Worldwide Hospitality and Tourism Themes*, vol. 7, no. 3, pp. 242–250, Jun 2015.

6. T. Lappas, G. Sabnis, and G. Valkanas, "The impact of fake reviews on online visibility: A vulnerability assessment of the hotel industry," *Information Systems Research*, vol. 27, no. 4, pp. 940–961, 2016.
7. K. A. Rouhan and M. T. A. Tonoy, "Borderless adventures: Empowering tourism with blockchain passports," in *International Conference on Innovation and Regenerative Trends in Tourism and Hospitality Industry (IRTTHI 2024)*, Punjab, India, 2024, pp. 238–250.
8. R. Sinha, Y. Sharma, N. Munjal, M. T. A. Tonoy, A. Paul, and A. Lakra, "Embracing decentralization: A blockchain database model for enhanced data operations," in *2024 IEEE Region 10 Symposium (TENSYP)*, IEEE, Sep 2024, pp. 1–6, doi: 10.1109/TENSYP61132.2024.10752319.
9. P. Kaur and A. Parashar, "A systematic literature review of blockchain technology for smart villages," *Archives of Computational Methods in Engineering*, vol. 29, no. 4, pp. 2417–2468, Jun 2022.
10. J. Oh, Y. Choi, and J. In, "A conceptual framework for designing blockchain technology enabled supplychains," *International Journal of Logistics Research and Applications*, vol. 26, no. 10, pp. 1315–1333, Oct 2023.
11. Sharma, H., Kumar, P., & Sharma, K. (2025). Intelligent Time Series Analysis for Intrusion Detection in the Internet of Things: A Generative-Adversarial-Network-Enhanced Convolutional-Neural-Network-Long-Short-Term-Memory Framework Using Signal Features. *Intelligent Computing*, 4, 0127.
12. Y. Maythu, A. O. J. Kwok, and P. L. Teh, "Blockchain technology diffusion in tourism: Evidence from early enterprise adopters and innovators," *Heliyon*, vol. 10, no. 2, Jan 2024.
13. V. Astarita, V. P. Giofre, G. Mirabelli, and V. Solina, "A review of blockchain-based systems in transportation," Jan 2020.
14. D. G. Takale, S. Damke, S. Damke, S. Mehra, S. Burkule, and N. Tadge, "Applications of blockchain in tourism industry," *Journal of Communication Engineering and VLSI Design*, pp. 8–15, Feb 2024.
15. Meda, R., Alam, I., Pandey, P., Dalal, R., & Khari, M. (2024, November). Enhancing Data Privacy with Lattice-Based Encryption Technique. In *International Conference on Intelligent Human Computer Interaction* (pp. 435-443). Cham: Springer Nature Switzerland.
16. Raj, T., Rana, V., Srivastava, A., & Sharma, H. (2025). Emergency Tweet Categorization and Prioritization. *Journal of Mobile Multimedia*, 21(3-4), 455-474..
17. R. L. Rana, N. Adamashvili, and C. Tricase, "The impact of blockchain technology adoption on tourism industry: A systematic literature review," *Sustainability*, vol. 14, no. 12, p. 7383, Jun 2022.

18. Sapra, P., Paikaray, D., Gusain, N., Abrol, M., Ramesh, S., & Bhardwaj, S. (2023). Evaluation of soft computing in methodology for calculating information protection from parameters of its distribution in social networks: P. Sapra et al. *Soft Computing*, 1-11.
19. Statista, "Share of travel reviews on tripadvisor deemed to be fake from 2018 to 2022, with a forecast for 2023," 2023. [Online]. Available: <https://www.statista.com/statistics/1448252/tripadvisor-fake-travelreviews/>
20. L. Huang, L. Li, W. Gao, and L. Zhang, "Research on evaluation index system of rural smart tourism platform based on blockchain technology," in *2023 IEEE 3rd International Conference on Computer Communication and Artificial Intelligence (CCAI)*, IEEE, May 2023, pp. 189–194.
21. Gupta, R., Gusain, N., Shirole, B. S., Jagtap, M. T., Thomas, S. A., & Kumar, S. A. N. T. O. S. H. (2025). Optimizing healthcare management systems with AI and machine learning. *South Eastern European Journal of Public Health*, 2973-2985..
22. Khan, S., Khari, M., & Azrou, M. (2025). IoT in retail and e-commerce. *Electronic Commerce Research*, 25(4), 3009-3010.
23. "Impact of blockchain technology on the governance of the tourism and hospitality industry," *Scientific Papers of Silesian University of Technology Organization and Management Series*, no. 203, 2024.