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Blockchain and Digital Marketing: An Innovative System for Detecting Fake Comments in Search Engine Optimization Techniques and Enhancing Trust in Digital Markets

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Abstract

A significant number of digital marketers use unethical marketing methods that violate Search Engine Optimization guidelines, with the objective of deceiving engines into displaying a specific website as the top result. The practice of fake comments constitutes a violation of Search Engine Optimization policies and is directly impeding market transparency. In addition, the absence of established standards between search engines, evaluation platforms and other trusted agencies makes exploitation easy. Therefore, in order to ensure fair competition among digital businesses, we propose a decentralized system for detecting fake comments, leveraging Blockchain technology for verification. The implementation of smart contracts as self-executing agreements will be achieved by utilizing the Ethereum network and the Truffle Suite. The Ethereum smart contracts will immutably record every comment as a transaction, eliminating any central authority. When a comment is flagged as suspicious, a digital business can trigger a verification request. Stakeholders or reviewers then vote on authenticity. Smart contracts collect these votes and issue a definitive verdict on whether the comment is fake.

Keywords: smart city; smart business; smart contract; Blockchain; transparency; Search Engine Optimization

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1. Introduction

Rapid urbanization and development of emerging technologies have stimulated the growth of smart cities around the world. These cities leverage interconnected systems and data analysis with respect to digital markets to provide all types of services, optimize their quality, enhance security, and improve quality of life for citizens. The importance of smart cities lies in their ability to address modern urban challenges, such as misinformation, fraud, and fraudulent activities in e-commerce, for a more comfortable lifestyle. They must also overcome challenges related to maintaining the integrity and authenticity of information. From another perspective, despite the variety of obstacles related to regulations, interoperability and transaction costs [1], the data integrity provided by Blockchain technology is highly beneficial. Its use in marketing has given rise to influential new aspects and various research programs concerning the emerging market prospects for reliable integration of Blockchain into digital marketing [2]. Furthermore, given the widespread adoption of SEO (Search Engine Optimization) in contemporary digital marketing strategies and the non-reputable techniques [3] that may result, we will look into the current state of Blockchain

technology and SEO and illustrate the Blockchain opportunities in digital marketing and SEO particularly.

However, before discussing those points, it is important to understand what SEO is. SEO is a technique that helps search engines understand and index websites. HTML anchor links help users navigate websites, improve the user experience, and boost SEO. SEO copywriting involves using keyword research and SEO strategies to create web content that attracts readers and ranks well in search engine results.

Applications of Blockchain have covered diverse domains, including digital currency, digital finance, digital society and, recently, digital marketing. However, there have been few studies on the role that Blockchain plays in the context of SEO. Previous relevant works have focused only on the possibility of using SEO in Blockchain. Consequently, questions remain unanswered about how Blockchain can help search engines, assist reviewing agencies fight fraudulent activities or black hat practices, and help firms and digital businesses enhance customers' trust. Currently, the key to business development is trust [4]: trust in digital businesses, websites, and brands represented on the Internet. It influences consumers' decisions about interactions and changes business entities' approaches to marketing activities. In this context, the potential of Blockchain's ability to guarantee trust, integrity, transparency, traceability, self-regulation and, in particular, data immutability makes it a valuable tool in the fight against fraudulent acts in the world of SEO such as fake comments or negative reviews. Liao et al. [5] and Weisstein et al. [6] discuss in their research that fake comments or negative reviews can damage a business and affect people's perceptions. Those harmful tactics are used by some businesses to affect the online reputation of their competitors. J, Charles et al. [7] highlighted that reputation is important for obvious reasons: it creates a positive impression, expands influence of the digital business, and distinguishes it from its competitors. For this reason, Blockchain might ensure fair competition between digital startups by combating fake comments. Unlike existing centralized detection systems that can be manipulated such as deep learning programs, our approach introduces a decentralized Blockchain ledger to ensure transparency and immutability and integrates search engines, ranking agencies, and digital businesses in a unified trust framework.

The objective of this article is to suggest an innovative model for fighting unethical SEO tactics such as fake comments. We proposed a decentralized Blockchain-based system capable of detecting and reviewing fake comments.

The rest of the paper is organized as follows: Section 2 describes the research methodology followed in the research. Section 3 presents an overview of the relevant research and the Blockchain opportunities in digital marketing and highlights the key intersection between Blockchain and SEO. Section 4 describes the strategies of digital marketing. Section 5 presents the impact of black hat SEO on disrupting trust in digital business. Section 6 highlights the key benefits of Blockchain for SEO. Section 7 examines the new model for detecting fake comments and provides an overview of the proposal fake comments detection system. Section 8 discusses the experimental results and the performances of this model before concluding the research work and sharing potential future research directions in Section 9.

2. Research Methodology

In this research study, we try to determine the impact Blockchain can have in the domain of digital marketing. A methodology is accordingly required. Blockchain can be applied to each area that requires an exchange between several users or stakeholders by integrating transactions into a unified platform, a guarantee of backup in a common database, and a proof system. Mixed theoretical–conceptual and chronological methods are

adopted in the research. The theoretical method consists of a review of the literature and the choice of conceptual method is justified by the variety of concepts and techniques used in Blockchain. Also, the chronological method was selected since the studied technology is very recent (2008) and therefore its evolution will be easily understood.

As a result, the selected methods for integrating the use of Blockchain in digital marketing must ensure trust between participating stakeholders and deliver significant benefits by respecting the following key concepts:

- Security: Data used in digital marketing is associated with security issues. It is important to maintain confidentiality by choosing a private Blockchain that allows only a restricted number of users to access and use the Blockchain.
- Transparency: In a Blockchain, each validated transaction generates a transaction hash that can be consulted by any participant. This makes it possible to verify that a specific action has been carried out on the Blockchain at a given time.
- Integrity: Integrity means maintaining consistency, accuracy and reliability of data throughout its lifecycle. To guarantee integrity, traceability data is hashed, and the hash is stored on the Blockchain. Since the Blockchain is tamper-proof, the hash can be considered tamper-proof by extension. Integrity verification involves calculating the hash of the data and comparing it with the original hash stored in the Blockchain.
- Confidentiality: Transparency does not mean that all information must be made public.

3. Literature Review

In the digital age, marketing has radically evolved. However, like all other technologies, the advent of digital marketing comes with risks and unethical practices such as fraud, which, therefore, compromises transparency and trust between customers and digital businesses at all levels.

Blockchain technology has had a significant impact on digital marketing and it is gradually becoming one of its application areas and a part of the SEO landscape. Therefore, it is evident that Blockchain solutions offer a high potential for integration with both digital marketing and SEO.

In the digital marketing era, several reviews of Blockchain solutions for eliminating the intermediaries in advertising and PPC are found [8]. Giving users control over their data and the ability to share it selectively to protect their privacy, enabling scalable, secure and anonymous search across massive datasets, allowing users to profit from their actions and enabling everyone to benefit significantly from decentralized collaboration [9] are the most characteristic benefits of integrating Blockchain and digital marketing technologies.

In the SEO world, Blockchain does not play a major role in SEO but there are some interesting ways in which Blockchain technology has been integrated. The primary intersection between Blockchain and SEO lies in the development of decentralized search engines [10] that solve the problem of traditional control by the existing search engines and allow users to contribute in search algorithms. Another way Blockchain and SEO intersect is smart contracts for SEO services. The amalgamation of smart contracts and search ecosystems [11] could automate payments for SEO and remove the need for intermediaries.

Additionally, Blockchain may transform content monetization [12] if Blockchain and SEO are mixed. This integration motivates and helps creators of valuable content to receive their compensation. The last important opportunity of Blockchain-based SEO analytics [13] is to provide real-time reporting and decentralized analytics for the practitioners of SEO, which would improve SEO performances.

Similar approaches in the literature focus on detecting fake news [14], responding to negative online reviews [15], and protecting websites from fake comment attacks that affect the trust of customers. Banerjee et al. (2017) [16] highlighted in their study that

responsiveness improves trust. For example, reviews will be more believable if they had responses from the business owner, even if they are only simple acknowledgements and the reviews are predominantly positive. However, research suggesting the use of Blockchain alongside other technologies in the various fake comment prevention processes is very rare. G Mckee Savitz [17] suggested many processes to help reduce the negative effects of mass and fake comments. In fact, the methods proposed in this work require the identity of commenters to be verified before a comment is submitted, which excludes comments from people who prefer anonymity.

4. Strategies for Digital Marketing

Digital marketing encompasses a variety of forms and strategies that businesses can utilize to enhance their visibility and improve their online reputation. One of the most dominant strategies today is email marketing, where businesses communicate directly with customers via email. Digital analysis refers to all activities involved in the operation of measuring, analyzing and interpreting information across all digital sources. With digital analysis, digital businesses are able to gather valuable customer insights, including information from social media accounts and emails. Social media and social networks have significantly transformed the way businesses influence consumer behavior, thanks to their unmatched ability to facilitate connection, interaction, and the collection of customer data. Another effective strategy is PPC and conversion optimization, which improve advertising performance to achieve maximum efficiency and return on investment. Mobile content is a different digital content displayed to the user by means of mobile internet technologies. Marketing of content for mobile offers high user friendliness.

Digital commerce, a branch of e-commerce, has expanded across multiple sectors, including online marketplaces [18], social commerce, mobile commerce, payment processing, supply chain logistics, and customer acquisition. SEM is another key digital marketing strategy that helps businesses to attract customers, increase online visibility, boost brand awareness, and drive traffic to their websites by helping them show up on SERPs.

5. Impact of Black Hat SEO on Disrupting Trust in Digital Business

5.1. Black Hat SEO Tactics

We can define black hat SEO tactics as any activity or technique that violates the terms of service of search engines like Google or Bing. The aim of those activities is to deceive search engines and obtain interesting natural positions that are not deserved. In this context, Aswani et al. (2018) [19] has classified a range of black hat SEO techniques, which include posting duplicate content to enhance content volumes, buying links to increase backlink volumes and backlink recommendation points, and using keyword spamming or stuffing keywords to increase keyword density in the content.

Other tactics include creating fake negative or positive reviewers for influencing consumers' purchasing decisions, cloaking and content snipping by providing camouflaged or hiding content, or article spinning, where content is copied from other websites.

Also, the rapid evolution of artificial intelligence may lead to inaccurate content. In this context, marketers use artificial intelligence language prediction models such as GPT-3. This tool uses artificial intelligence to translate a written input (essentially a prompt) with incredible accuracy. GPT-3 is effectively an auto-complete tool that looks at the previously written content and cross-references it to its repository of data to determine what should come next. It does not have a semantic understanding of the text it produces, which can lead to inaccurate and sometimes incoherent or even contradictory writing. For example, Google may take actions on such content if it is 100% machine-generated.

Additionally, black hat practices involve misusing of Schema Markup, utilizing private blog networks or webrings to make a website appear more connected to others, and engaging in blog comment spam. Sponsored pages and posts, rich snippets, doorway websites and pages, and misleading redirects are also common tactics.

Lastly, negative SEO, which aims to harm the performance of competitors' websites, is another form of black hat SEO activity.

5.2. The Impact of Black Hat SEO on Disrupting Trust in Digital Business

SEO represents a considerable challenge. Improving websites to enhance their ranking in search engine results helps digital businesses to attract more traffic. Furthermore, in the age of social proof, trust with consumers is paramount and online reputation can make or break digital businesses.

White hat SEO helps build trust between clients and digital businesses. In the contrary, black hat SEO leads visitors to land on spoofed websites. They might find poorly spun content, spam links, fake comments and fraudulent ads. This negative user experience might affect the brand of digital businesses.

In addition, visitors may leave bad reviews. This negative feedback might be directed at a scam site, but the victims will blame digital businesses if it was under their brand name. The bad press can deter other customers. Also, search engines make it very clear if any violate their guidelines and might penalize digital companies if their quality scores are fairly lowered. For example, Google might banish websites for a long time from search results if they do not respect Google standards and guidelines.

Ultimately, using black hat SEO tactics means lower-ranking positions and most likely a decline in organic traffic. Therefore, specialists recommend using white hat SEO techniques instead.

6. Key Benefits of Blockchain for SEO

6.1. Definition of Blockchain

Blockchain can be defined as both a network and a database. A record of transactions, especially those made in a cryptocurrency, is maintained across computers connected in a peer-to-peer network in a system. In the recent years, Blockchain has spread to reach many other potential applications such as donation management, medical record, supply chain management, governance, and more, where disintermediation, trust, transparency, security and data immutability are crucial. To reach an agreement among participating nodes and assure decentralized operations, consensus mechanisms and communication protocols are invented.

The selection of protocols (proof of Work, proof of Stake, proof of Burn, etc.) to be adopted is contingent upon the type of Blockchain, which may be categorized as either public, private, hybrid, or consortium.

6.2. How Unethical SEO Tactics Can Be Fought with Blockchain

The desire of digital companies to maintain a positive online reputation and make advances in e-commerce should also prompt consideration of new evaluation technologies. Many e-commerce businesses are suffering from fake comments and are trying to verify whether the customer really bought the product from them or if the comment is just a fake reviewer trying to make a bad comment.

Because it is incorruptible, offers incentives to encourage community participation, and is based on an advanced cryptographic system that ensures transparency and combats fraudulent acts, Blockchain can combat unethical SEO tactics. In fact, this technology has become more powerful due to the use of smart contracts that are able to run and self-execute

some tasks when predetermined conditions are met. Thus, issues related to reviewing and fake comments may be addressed if Blockchain and SEO are mixed.

7. A Novel Blockchain-Based System for Detecting Fake Comments

In this research study, we present a detailed architecture of our proposed innovative system. The system is decentralized, reliable and autonomous and able to verify the authenticity of comments and ensure fair competition for digital businesses and all types of websites. Its architecture guarantees a high degree of confidence and ensures the security, integrity and confidentiality of the processing and flows exchanged between its various entities.

7.1. Detecting Fake Comments Model

To ensure transparency in digital business environments, we suggested a new Blockchain-based system model. The following diagram illustrates the model used for detecting fake comments. This model is designed for the collection and verification of fake comments by ranking agencies and reviewers. Search engines must be able to respond to all requests from digital businesses and e-commerce sites by indicating whether or not they consider a comment to be fake.

Figure 1 shows how different stakeholders interact with the Blockchain to verify the authenticity of comments. The key components and flow are as follows:

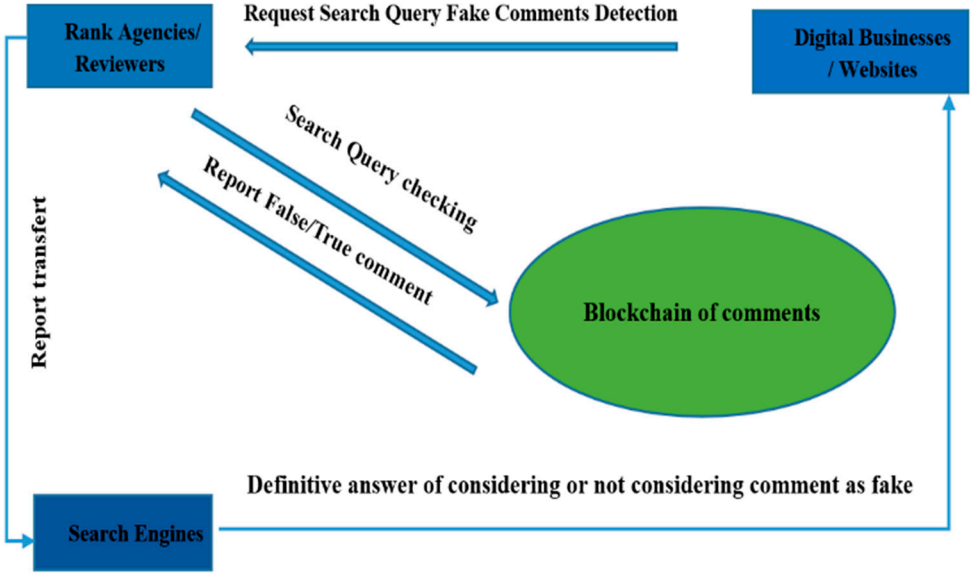

Figure 1. Blockchain-based system for detecting fake comments.

1. **Digital Businesses/Websites**: These are online platforms where users leave comments. They initiate the process by requesting detection of fake comments.
2. **Rank Agencies/Reviewers**: These are independent bodies or individuals that evaluate the credibility of comments. They request fake comment detection and receive validated results from the Blockchain system.
3. **Search Engines**: These rely on authentic information to rank websites fairly. They receive a definitive answer (true or fake) about comments from the Blockchain and use this to refine website ranking.
4. **Blockchain of Comments** (Core System): This acts as the trust layer and stores comments in an immutable ledger. Representatives of Rank Agencies, chosen reviewers, or independent individuals will be elected as voters and incentivized to vote in the system according to the chosen consensus. The reputation of the commenter [20] is

just as important as the comment itself and trustworthiness of the commenter could be a determining factor in the vote. After votes, a definitive verdict on whether the comment is fake is given. Finally, they provide a report back to the businesses and search engines.

7.2. The Suggested Architecture of the New Model

Figure 2 describes the main components of the new model for fighting fake comments. Regarding the type of database for the implementation of the proposed system, decentralized Blockchain (Ethereum) allows for storing data with high security and establishing a peer-to-peer network to eliminate the need of intermediaries and verifying application through smart contracts that remove the need of third parties.

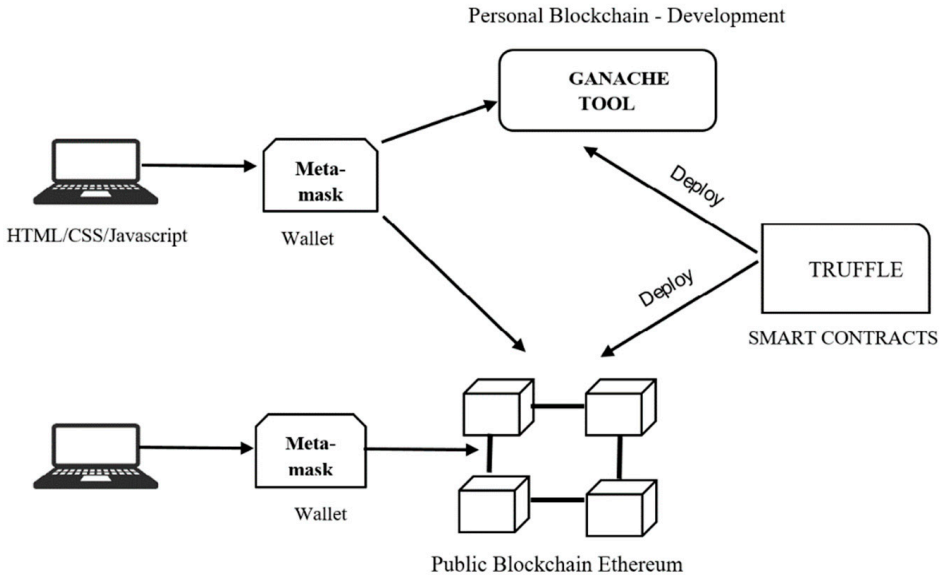

Figure 2. Architecture of the proposed system.

For this reason, we implemented Ganache, which is part of the Truffle Suite of tools. That tool provides an Ethereum Blockchain with 10 unlocked accounts pre-funded with Eth, allowing us to test our Solidity smart contracts quickly and simulate different users of our system.

To develop our system, we needed to write smart contracts in the Solidity language. We used Truffle Suite for the VS code. Due to the immutable nature of Blockchain, we fully tested and checked the correctness of the code before deploying it on the Blockchain network.

We chose VS code because it simplifies the entire development process by offering tools to automate contract compilation, testing and deployment. This reduces development time, ensures reliability and allows digital businesses to quickly adapt to changing needs.

In addition, to communicate with the Blockchain, we used MetaMask 13.2.2 which is a software cryptocurrency wallet. This tool allows us to interact with the Blockchain from the client side through the web browser or using mobile application extension. Then, digital businesses can make transactions by sending Ethers, as illustrated in Figure 3.

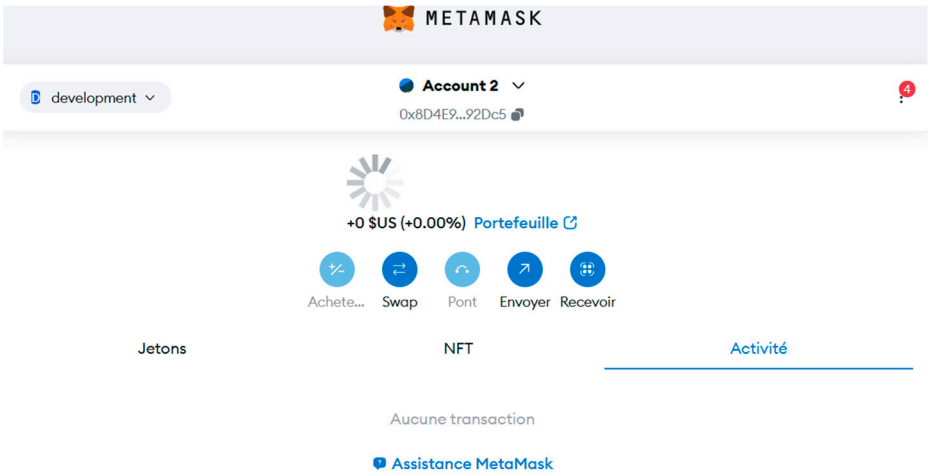

Figure 3. Interactions with the Blockchain.

8. Results and Discussion

8.1. Results

Experimental investigation of the proposed system was conducted on Ganache CLI, which is the latest version of Test RPC. We chose Ganache for this because it is a fast and customizable Blockchain emulator that allows us to make calls to the Blockchain without an actual Ethereum node.

1. Transactions are mined instantly.
2. There is no transaction cost.
3. Gas price mining speed and network parameters can be modified.
4. A convenient GUI gives an overview of the test chain events.
5. Accounts can be recycled, reset and instantiated with a fixed amount of Ether (no need for faucets or mining).
6. Only 10 accounts are needed.

Although this tool provides a limited number of Ethereum accounts as illustrated in Figure 4, this setting is not truly tunable in the sense that a larger value of this parameter will always lead to more stable results than a smaller value of this parameter.

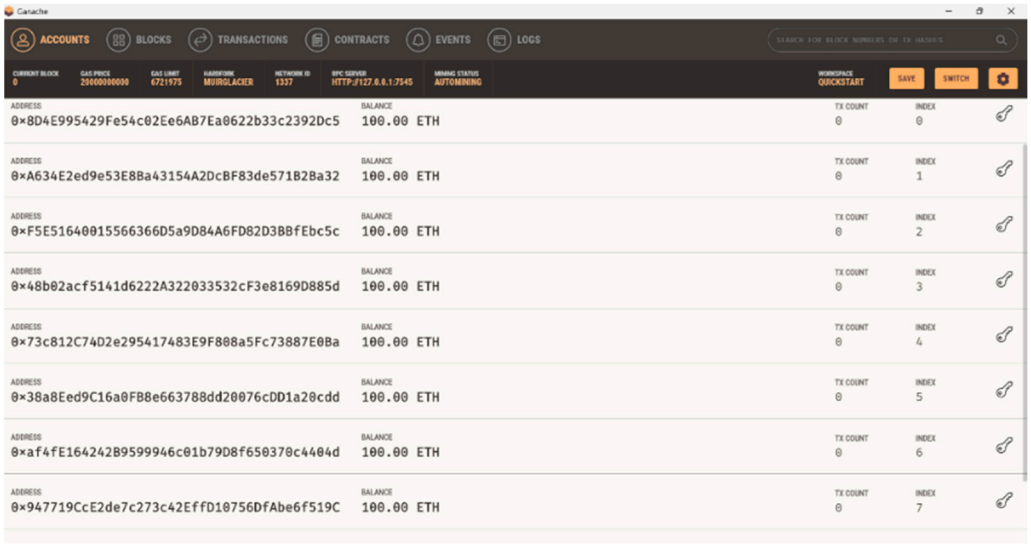

Figure 4. Blockchain network with 10 accounts.

Once the voter has cast the vote, an email receipt is provided to assure the voters that their votes have been recorded as intended, and they can see the entire summary of results that are immediately available for view at any time, as shown on the votes and results page in Figure 5. This page clearly shows that, in the proposed system, we can add other pages such as publication of results or downloading certified results.

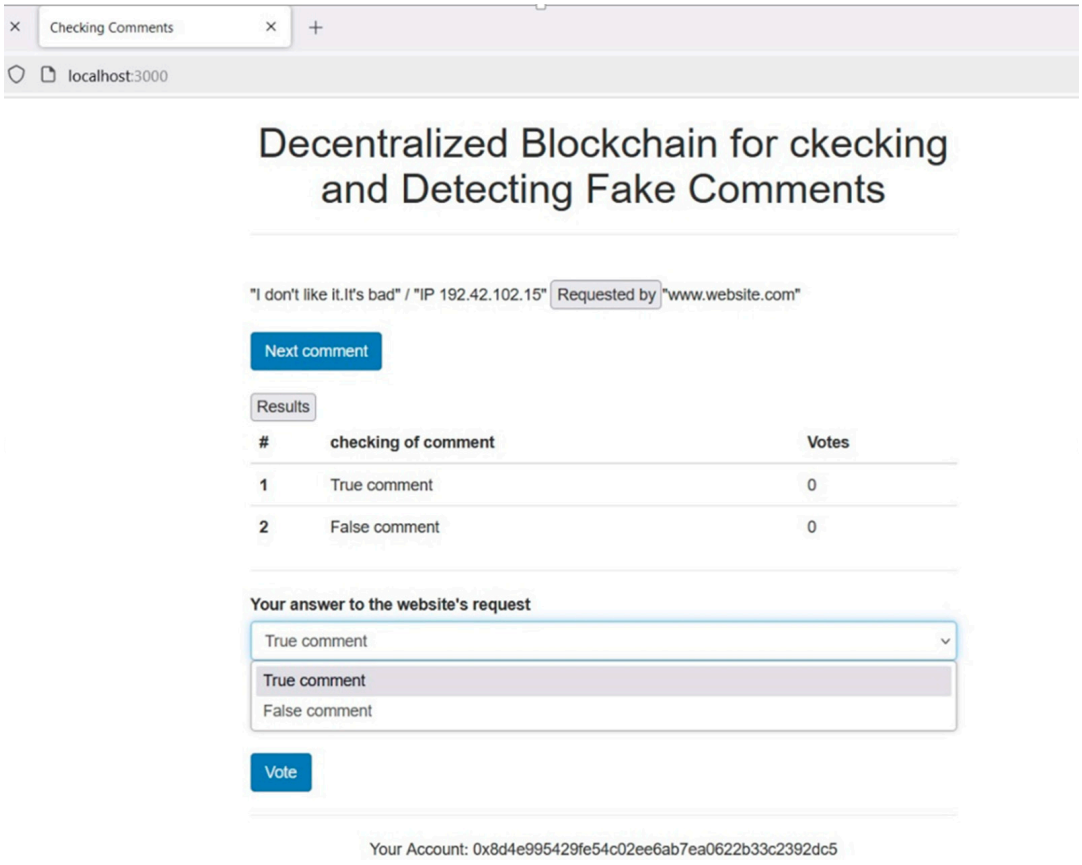

Figure 5. Votes and results page.

8.2. Performance Analysis and Effectiveness Evaluation

A complete system is proposed in this work based on voting mechanism and consortium Blockchain. Before deploying it for production, it is very important to test the security, availability, and the speed of the current system. After evaluation, we observed that our system can operate with consistently high performance. Figure 6 shows that our Ethereum Blockchain transactions were processed quickly, providing high speed to our system. Regarding security concerns, our system offers high security due to predetermined smart contracts. A comment is considered fake when it receives at least 51% of votes.

Concerning system availability, the ability of all nodes or members of the checking network to access data on the ledger reinforces the availability of our system. The evaluation of the effectiveness of our system focuses on the following question: how can we classify voters while receiving a significant amount of Ether as a reward? We can classify the participants depending on their motivation to actively participate in the voting process.

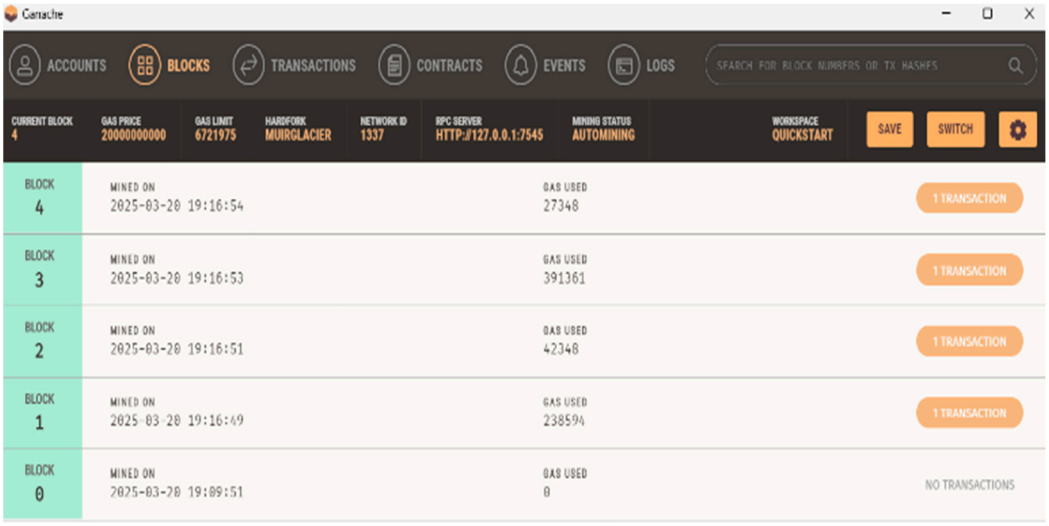

Figure 6. Validation of 4 blocks within 5 min.

8.3. Discussion

In the world of SEO, the proposed system was found to be one of the best systems for fighting fake comments, ensuring greater transparency within SEO activities, eliminating intermediaries, and guaranteeing confidentiality, anonymity and accuracy of the votes which cannot be changed or deleted in any way. However, it has the disadvantage of being vulnerable to some risks such as hacking, malicious software programming, high expenses of machines, secure storage of transactions, vulnerability of smart contracts to double-spending, and compromising of encryption keys.

To overcome this, the encryption algorithms used in the current system must allow mathematical operations to be performed on encryption data without decryption. In addition, the new model has many benefits in combatting black hat SEO tactics. It provides new methods for checking comments and improving transparency and trust in digital world. In a large scale and with the non-homogeneity of digital markets, storing all comments and costs of transactions for votes are a big challenge. To address storage issues, the system needs enhancement to be used by search engines. Regarding transaction costs, they depend on the Ether-USD market. Currently, it costs USD 0.0091875 to cast one vote, which is a small price to pay for transparency in digital markets.

9. Conclusions and Future Work

Integrating Blockchain and SEO can be a productive solution for fighting unethical SEO activities in digital markets. In this work, we have presented examples of manipulative marketing tactics against SEO. Moreover, we have suggested a new model to efficiently fight unethical methods in digital marketing, and we have seen how this innovative system solves the problem of fake comments and how it could reinforce transparency in digital markets.

It includes a search query system that allows review platforms, trusted agencies, rank agencies and search engines to check request queries of fake comments daily from websites, as well as feed detection and deleting fake comments from business or e-commerce websites. Our architecture uses decentralization and smart contracts that ensure agreements in the context of digital marketing to enhance trust between all parties, as they can be assured that no alterations can be made after the contract's deployment.

Experimental results show that this new system exhibits high performance. Based on the vote mechanism and consortium Blockchain, the proposed system gives accurate results and can be applied to analogous problems. Ultimately, the application of Blockchain

technology to digital marketing is still in its early stages. Further investigation and research are required to determine which Blockchain tools can be integrated into digital marketing.

In future works, we plan to explore the potential implications of international digital companies, search engines, and trusted agencies.

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Abbreviations

The following abbreviations are used in this manuscript:

GPT-3	Generative pre-trained transformer 3
GUI	Graphical user interface
PPC	Pay per click
SEM	Search engine marketing
SEO	Search engine optimization
SERPs	Search engine results page
VS	Visual studio

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