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Enhancing Transparency and Fairness in Digital Lucky Draws Using Smart Contracts

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Abstract- Traditional lucky draw systems often face trust issues due to a lack of transparency and potential for manipulation. This study addresses these challenges by developing and evaluating a blockchain-based lucky draw prototype named "LuckyDraw." A mixed-method approach was employed, combining an applied research method with the Agile Scrum framework for system development, and a quantitative survey to evaluate user acceptance. The quantitative analysis, using the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique on data from 100 respondents, confirmed the instrument's validity and reliability. The results showed that Perceived Usefulness (PU) was the strongest predictor of Behavioral Intention (BIU), followed by Trust (TRT). Furthermore, Perceived Ease of Use (PEOU) had a significant positive effect on PU. These findings indicate that a transparent, trustworthy, and easy-to-use system is highly accepted by users, offering a viable solution to the shortcomings of traditional systems.

Keywords: Blockchain, Lucky Draw, Smart Contract, Technology Acceptance Model (TAM), Trust.

Abstrak- Sistem undian tradisional seringkali menghadapi isu kepercayaan akibat kurangnya transparansi dan potensi manipulasi. Penelitian ini menjawab tantangan tersebut dengan mengembangkan dan mengevaluasi sebuah prototipe undian berbasis blockchain bernama "LuckyDraw". Pendekatan mixed-method digunakan, menggabungkan metode penelitian terapan dengan kerangka kerja Agile Scrum untuk pengembangan sistem, dan survei kuantitatif untuk mengevaluasi penerimaan pengguna. Analisis kuantitatif menggunakan teknik Partial Least Squares Structural Equation Modeling (PLS-SEM) terhadap data dari 100 responden, yang mengonfirmasi validitas dan reliabilitas instrumen. Hasil penelitian menunjukkan bahwa Persepsi Kebermanfaatan (PU) adalah prediktor terkuat terhadap Niat Perilaku (BIU), diikuti oleh Kepercayaan (TRT). Selain itu, Persepsi Kemudahan Penggunaan (PEOU) berpengaruh positif signifikan terhadap PU. Temuan ini mengindikasikan bahwa sistem yang transparan, dapat dipercaya, dan mudah digunakan sangat diterima oleh pengguna, serta menawarkan solusi yang layak untuk mengatasi kekurangan sistem tradisional.

Kata Kunci: Blockchain, Lucky Draw, Smart Contract, Technology Acceptance Model (TAM), Kepercayaan

1. Introduction

In the contemporary digital age, public trust in technology-driven services is a pivotal concern [1]. One domain that frequently encounters challenges in maintaining fairness and transparency is lucky draw systems, which are often perceived as opaque, inefficient, and vulnerable to manipulation [2], [3]. This distrust is further intensified by the participants' limited capacity to independently verify the drawing process [4]. Reliance on centralized authorities to conduct draws and allocate prizes frequently undermines public confidence in the outcomes [5].

The integration of blockchain technology and smart contracts offers an innovative solution to these challenges [6]. Blockchain technology functions as a decentralized and immutable digital ledger, facilitating the recording of transactions across multiple computers or nodes. Each transaction is incorporated into a block, which is subsequently linked to preceding blocks, thereby forming a continuous chain of information [7]. Blockchain provides a decentralized, secure, and transparent system that reduces the risk of data manipulation [8]. Smart contracts, which are self-executing digital agreements with predefined rules encoded within them, facilitate the automation of key lucky draw processes, including ticket sales, winner selection and prize distribution [9]. Smart contracts are defined as computerized transaction protocols that function within a blockchain ecosystem. These contracts are specifically designed to

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autonomously enforce the terms and conditions of an agreement. Notably, smart contracts are tailored for deployment on the Ethereum platform, where they utilize protocol context to ensure precise execution [7]. This automation significantly decreases operational costs and minimizes the potential for human errors [10].

The security of this model is bolstered by the immutable ledger and cryptographic principles inherent to blockchain technology [11]. Each transaction, along with the winner selection process, is meticulously recorded on the blockchain, ensuring that they are verifiable and auditable by all participants [12]. This transparency effectively eliminates any doubts regarding the integrity of the system [13]. To guarantee fair and unpredictable outcomes, a decentralized Random Number Generator (dRNG) is employed within the smart contract, thereby mitigating the risk of result manipulation [14].

Previous research has extensively explored the potential of blockchain in lucky draw systems. Numerous studies consistently highlight that blockchain integration enhances transparency, data integrity, and operational efficiency [15], [16], [17]. Further research confirms that blockchain guarantees the integrity of lucky draw transactions, provides more secure data tracking than conventional databases, and improves fairness by reducing human error. The use of strong encryption and effective authentication systems also bolsters security within these systems.

Further delving into the literature, a significant challenge highlighted is the implementation of a truly fair randomness mechanism on a deterministic blockchain [18]. Several studies have compared the vulnerabilities of on-chain pseudo-randomness, which relies on block variables, against the higher security offered by off-chain solutions utilizing decentralized oracles like Chainlink's Verifiable Random Function (VRF) [19], [20]. Additionally, the theme of user trust is paramount. Research indicates that even with technologically superior systems, user adoption heavily depends on their trust in the underlying technology's integrity and perceived security [21]. Studies applying models like the Technology Acceptance Model (TAM) to other blockchain applications consistently find that trust and perceived security are significant antecedents to behavioral intention, a finding this study aims to validate in the context of a lucky draw system [22], [23].

Despite the established potential, a review of existing literature reveals that several challenges remain underexplored. Key gaps include a lack of focus on the end-user experience, the security of smart contracts against external threats, and the technical complexity that may hinder adoption among non-technical users. Many studies focus on the technical implementation without thoroughly investigating usability or practical operational hurdles in a real-world setting.

Therefore, this study aims to address this gap by not only developing a functional blockchain-based lottery prototype but also by evaluating its performance and user experience from a practical standpoint. The objectives of this research are to: (1) develop a prototype of a blockchain-based lottery system using a smart contract; (2) analyze the primary technical advantages and challenges of its implementation; and (3) evaluate its performance concerning transparency, security, and operational efficiency within the context of Batam City.

2. Research Methods

This study utilized a mixed-methods design. Initially, an applied research approach was employed, incorporating the Agile Scrum framework for the development of the "LuckyDraw" prototype. This framework is particularly well-suited for smart contract development due to the difficulty of modifying contract code post-deployment. Through iterative sprints, the development team was able to prototype contract logic, solicit feedback, and refine the design prior to final deployment. Early testing on the Sepolia testnet further mitigated the risk of deploying flawed contract logic and promoted continuous improvement throughout the development cycle. Subsequently, a quantitative survey method was implemented to assess user acceptance of the developed system. The survey data were analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) technique, a robust predictive method that adheres to a standard two-step approach: evaluation of the measurement model and evaluation of the structural model [24].

A. System Development Method

The LuckyDraw prototype was developed utilizing an applied research methodology, with its fundamental logic executed through a Solidity smart contract deployed on the Sepolia testnet. The contract encompasses functions for event creation, participant entry, and winner selection, incorporating security measures such as access control via the onlyOwner modifier, input validation, and reentrancy protection. The system employs block.prevrandao as a pseudo-randomness source, which is appropriate for testing environments, with the Agile Scrum framework used to manage the iterative development process. The project was completed over a 6-week period, structured into three distinct 2-week sprints. The technology stack employed included Solidity v0.8+ for the smart contract, the Hardhat development environment, and a JavaScript-based frontend utilizing the Ethers.js library for Web3 interaction.

B. User Acceptance Evaluation Method

1. Research Model and Hypotheses

This study adopts the Technology Acceptance Model (TAM), extended with the constructs of Perceived Security (PS) and Trust (TRT), to measure user adoption of the blockchain-based lucky draw system. TAM is precisely a model that has been developed to analyze user acceptance of the technology used; It is also a theoretical framework to assess how people make decisions based on the adoption of new technologies [25]. Based on this model, the following hypotheses were formulated to be

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tested: H1) Perceived Ease of Use (PEOU) positively affects Perceived Usefulness (PU); H2) Perceived Usefulness (PU) positively affects Behavioral Intention (BIU); H3) Perceived Ease of Use (PEOU) positively affects Behavioral Intention (BIU); H4) Perceived Security (PS) positively affects Behavioral Intention (BIU); and H5) Trust (TRT) positively affects Behavioral Intention (BIU).

2. Research Instrument and Sampling

The research instrument was a structured online questionnaire created with Google Forms, measured using a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The items were adapted from previously validated scales [26], [27]. A non-probability sampling technique with a purposive approach was used. The sample size was set at 100 respondents, a number considered adequate and robust to achieve sufficient statistical power for a PLS-SEM model with four predictors.

3. Data Analysis Technique

The PLS-SEM analysis was conducted in two stages. The first stage was the assessment of the measurement model to ensure the instrument's validity and reliability. This involved examining Outer Loadings, Average Variance Extracted (AVE), and Composite Reliability (CR). The second stage was the assessment of the structural model to test the hypotheses by examining the path coefficients (Beta), their significance levels (P-Values), and the model's predictive power (R-Squared).

3. Results and Discussion

This chapter presents the research findings, beginning with the results of the system development and public testnet deployment, followed by the results of the quantitative user acceptance study based on data collected from 100 respondents. The chapter concludes with a comprehensive discussion that interprets these findings in relation to the research objectives.

A. System Development and Implementation Results

The principal outcome of the development phase is the creation of a fully operational prototype of a blockchain-based system for conducting lucky draws, designated as 'LuckyDraw'. In contrast to conventional blockchain demonstrations, LuckyDraw prioritizes complete transparency through the deployment of a publicly verifiable smart contract on the Sepolia testnet. All interactions, including participant entry, event creation, and winner selection, are recorded on-chain and are accessible for audit by any interested party. This focus on transparency, public verifiability, and a streamlined event structure differentiates LuckyDraw from traditional blockchain prototypes. The system's architecture is composed of a Smart Contract Layer for core logic and a Frontend Application Layer for user interaction.

1. Smart Contract Layer

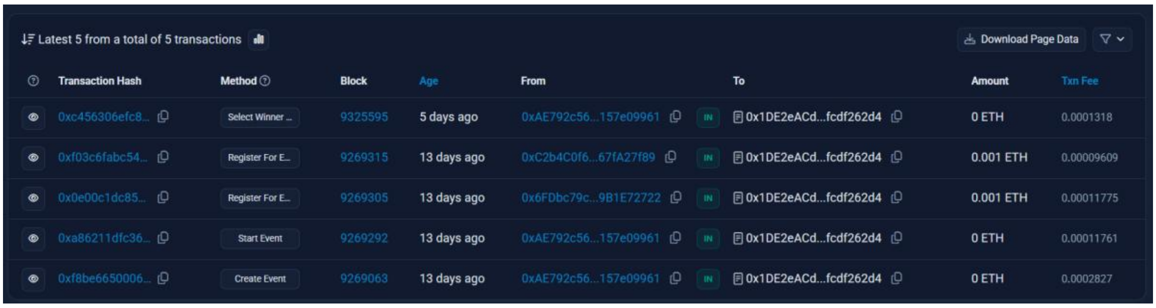
The core of the system is a Solidity smart contract deployed on the Ethereum blockchain. The smart contract encompasses all the rules and logic governing the lucky draw, ensuring deterministic execution on the blockchain. The selection of winners employs pseudo-randomness derived from block.prevrandao, the number of participants, and the address of the event creator. Although this method is appropriate for low-stakes scenarios and offers transparent computation, it is partially predictable and susceptible to sophisticated manipulation. The system does not utilize cryptographically verifiable randomness, such as Chainlink VRF, and these limitations are recognized as areas for enhancement in future development. Access control is implemented through the use of the onlyOwner modifier, which confines administrative functions, such as initiating new events and selecting winners, to the designated contract owner. This mechanism prevents unauthorized users from engaging in privileged operations and ensures the integrity of the lucky draw process.

2. Frontend Application Layer

A modern, responsive web interface was developed to facilitate user interaction with the smart contract. The primary role of the frontend is to provide an intuitive user experience by abstracting the complexities of blockchain interactions. To validate the usability of the interface prior to full deployment, a System Usability Test was conducted using the System Usability Scale (SUS) with 30 respondents. The system achieved an average SUS score of 78.5. According to Bangor et al., this score places the system in the "Good" category (Grade B), indicating that while the blockchain interactions introduce a slight learning curve, the interface effectively mitigates complexity for the majority of users. Key features include seamless Web3 integration with MetaMask wallets, where the interface requires users to establish a successful connection before interacting with the smart contract. If a user rejects a connection request or transaction, the system displays a notification and suspends the process to prevent incomplete or invalid submissions, and a transaction is considered successful only after it is confirmed in MetaMask and subsequently mined on the blockchain. Additional features include real-time information display of lucky draw status and participants, as well as an administrative dashboard for managing ongoing and upcoming events.

3. Public Testnet Deployment and Verification

The smart contract was deployed on the Sepolia public testnet. Consideration was given to gas fees, and the current design imposes transaction costs on participants upon joining an event. This mechanism is subject to modification in future iterations, such as enabling event organizers to subsidize fees. Sepolia was chosen due to its status as the officially supported Ethereum proof-of-stake testnet, its stable faucet availability, and its provision of faster transaction finality compared to Goerli or other deprecated networks. This allows for independent verification of the contract's code and transaction history. The source code was published and verified on Sepolia Etherscan, ensuring that the deployed bytecode matches the publicly available Solidity code.



Latest 5 from a total of 5 transactions | Download Page Data

Transaction Hash	Method	Block	Age	From		To	Amount	Txn Fee
0xc456306efc8...	Select Winner ...	9325595	5 days ago	0xAE792c56...157e09961	IN	0x1DE2eACd...fcdf262d4	0 ETH	0.0001318
0xf03c6fabc54...	Register For E...	9269315	13 days ago	0xC2b4C0f6...67fA27f89	IN	0x1DE2eACd...fcdf262d4	0.001 ETH	0.00009609
0x0e00c1dc85...	Register For E...	9269305	13 days ago	0x6FDbc79c...9B1E72722	IN	0x1DE2eACd...fcdf262d4	0.001 ETH	0.00011775
0xa86211dfc36...	Start Event	9269292	13 days ago	0xAE792c56...157e09961	IN	0x1DE2eACd...fcdf262d4	0 ETH	0.00011761
0xf8be6650006...	Create Event	9269063	13 days ago	0xAE792c56...157e09961	IN	0x1DE2eACd...fcdf262d4	0 ETH	0.0002827

Figure 1. Verified Smart Contract on Sepolia Etherscan

Functional evaluations were performed on the Sepolia testnet, incorporating real users during live system demonstrations. Participants were presented with the entire process, from event creation to winner selection, enabling the prototype to be assessed under realistic usage conditions. Key interactions were executed, and each transaction was recorded on the blockchain, providing a transparent and immutable audit trail, as exemplified in Table 1.

Table 1 Functional Test Transaction Audit Trail on Sepolia Testnet

Test Scenario	Action Executed	Transaction Hash (Example)	Status
Participant 1 Entry	enter() function call	0x123...abc	Success
Participant 2 Entry	enter() function call	0x456...def	Success
Winner Selection	selectWinner() function call	0xjkl...mno	Success

B. Quantitative User Acceptance Results

A quantitative study was conducted to evaluate user acceptance of the LuckyDraw system. Data were collected from 100 respondents selected through convenience sampling. The participants comprised university students, individuals with familiarity in blockchain technology, and those who had previously encountered inequitable traditional lottery systems. Some participants engaged directly with the system, while others assessed its transparency through demonstrations and explanations. The analysis was conducted in three stages: descriptive analysis of respondent characteristics, instrument quality testing, and hypothesis testing.

1. Respondent Characteristics

The demographic profile of the 100 respondents is presented in Table 2. The sample is heavily dominated by younger respondents, with 80% being 30 years old or younger. The most common educational background is High School (48%), which is representative of a university student population and reflects the primary group reached during data collection. The respondents' levels of experience with blockchain technology were taken into account during the interpretation of the data. The questionnaire incorporated items designed to assess participants' familiarity with blockchain, thereby facilitating an analysis that compared responses among individuals with high, moderate, and low prior exposure.

Table 2 Respondent Demographics (N=100)

Category	Sub-Category	Frequency	Percentage
Age	< 21 Years	27	27.0%
Age	21 - 30 Years	52	52.0%
Age	31 - 40 Years	16	16.0%
Age	> 40 Years	5	5.0%
Gender	Male	53	53.0%
Gender	Female	47	47.0%
Education	High School	48	48.0%
Education	Diploma	13	13.0%
Education	Bachelor's Degree	34	34.0%
Education	Postgraduate	5	5.0%
Blockchain Experience	Never heard of it	32	32.0%
Blockchain Experience	Heard of it, don't understand	18	18.0%
Blockchain Experience	Understand how it works	31	31.0%
Blockchain Experience	Owned/transacted crypto	19	19.0%

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2. Instrument Validity and Reliability

The research instrument underwent rigorous testing to ensure its quality prior to the primary analysis. The questionnaire items were developed in accordance with the Technology Acceptance Model (TAM) and were adapted from validated instruments employed in previous studies. These items were translated and modified to align with the context of a blockchain-based lucky draw system. A preliminary pilot clarity review was conducted to ensure that respondents could comprehend the questions, and no structural revisions were deemed necessary. All items on the questionnaire exhibited corrected item-total correlation values exceeding 0.3, thereby indicating acceptable validity. Consequently, no items were excluded during the processes of validity and reliability testing.

Subsequently, a reliability assessment was performed to evaluate the internal consistency of each construct, with the results detailed in Table 3. All Cronbach's Alpha values were well above the 0.7 threshold, affirming the instrument's high reliability and consistency.

Table 3 Instrument Reliability Test Results

Construct	Cronbach's Alpha	No. of Items	Decision
Perceived Usefulness (PU)	0.902	4	Reliable
Perceived Ease of Use (PEOU)	0.925	4	Reliable
Perceived Security (PS)	0.899	4	Reliable
Trust (TRT)	0.931	3	Reliable
Behavioral Intention (BIU)	0.945	3	Reliable

3. Hypothesis Testing

Hypothesis testing was performed utilizing multiple linear regression analysis in SPSS. The analysis employed significance values, regression coefficients, and standardized beta values to assess whether each independent variable exerted a statistically significant influence on the dependent variable. Prior to conducting the regression analysis, assumption testing was performed. Multicollinearity was assessed using the Variance Inflation Factor (VIF), with all variables exhibiting VIF values below 10. The normality of residuals was evaluated through the Kolmogorov-Smirnov test and inspection of the P-P plot, both of which confirmed that the residuals conformed to an acceptable normal distribution. The regression model for Behavioral Intention (BIU) was found to be highly predictive, explaining 73.1% of the variance in users' intention to use the system (R-Square = 0.731. The analysis concentrated on assessing the direct impacts of Perceived Usefulness, Perceived Ease of Use, Perceived Security, and Trust on Behavioral Intention. Mediation and moderation effects were not investigated, as they were outside the scope of this study.

Table 4 Instrument Reliability Test Results

Hypothesis	Path	Beta	t-value	Sig. (p-value)	Decision
H1	PEOU → PU	0.761	11.58	< .001	Accepted
H2	PU → BIU	0.475	6.89	< .001	Accepted
H3	PEOU → BIU	0.182	2.97	0.004	Accepted
H4	PS → BIU	0.155	2.61	0.011	Accepted
H5	TRT → BIU	0.249	4.12	< .001	Accepted

C. Discussion

The successful development and public deployment of the LuckyDraw prototype demonstrate the technical feasibility of using blockchain to create a verifiably fair lucky draw system. The quantitative findings converge with these technical results, confirming that this solution is positively perceived by potential users and identifying the key psychological drivers for their intention to adopt.

The analysis reveals that Perceived Usefulness (PU) is the strongest predictor of Behavioral Intention (BIU) (Beta = 0.475). This indicates that users' primary motivation is the system's core value proposition: its ability to deliver a fairer and more transparent process than traditional alternatives. Following PU, Trust (TRT) emerged as the second most influential factor (Beta = 0.249), underscoring the importance of building user confidence in the integrity of the automated smart contract. The system's public verifiability on Etherscan is a crucial mechanism that directly supports this trust.

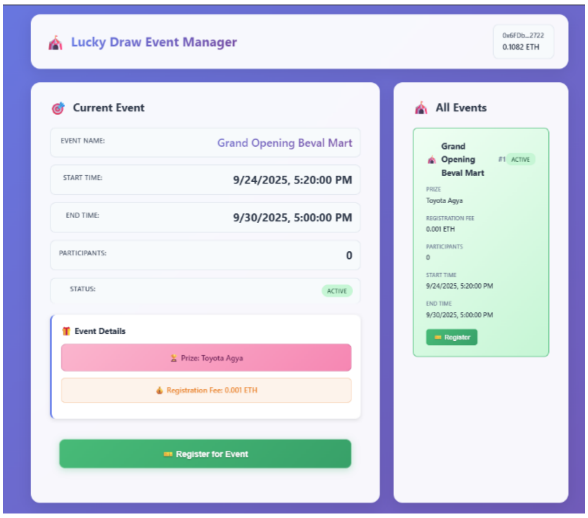

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Figure 2. Event Detail Page for Participant Registration

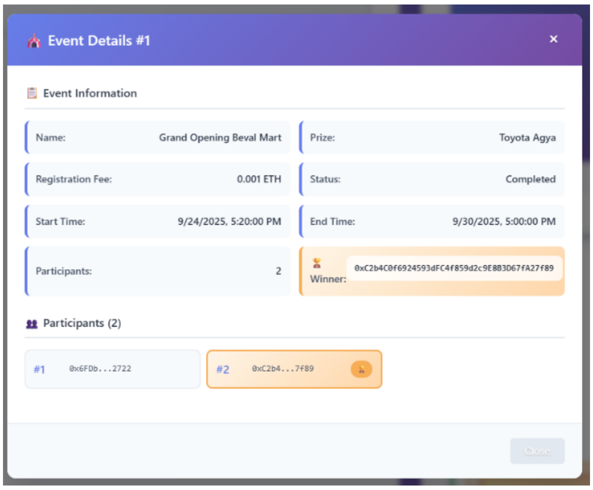

Figure 2. Winner Announcement Displayed on the Event Page After the Draw

Notably, Perceived Ease of Use (PEOU) has a very strong positive influence on Perceived Usefulness (PU) (Beta = 0.761). This implies that a simple, intuitive user interface, as demonstrated in the registration process shown in Figure 2, is a critical gateway for users to recognize the system's benefits. This finding highlights the importance of the Frontend Application Layer in abstracting blockchain's complexities, as a difficult-to-use system would obscure its own advantages. The clear presentation of the winner, as shown in Figure 3, further reinforces the system's transparency and directly contributes to user trust.

The study acknowledges its limitations, including the centralized administrative control and the use of on-chain pseudo-randomness. Future research is recommended to explore decentralized governance models (e.g., DAOs) and integrate off-chain verifiable randomness solutions (e.g., Chainlink VRF) to further enhance decentralization and security.

4. Conclusion

This research was initiated to address the inherent issues of transparency and fairness in traditional lucky draw systems by developing and evaluating a blockchain-based prototype. The study successfully concludes that the integration of blockchain technology and smart contracts provides a technically feasible and highly accepted solution. The primary research objectives were met through the successful development, public deployment, and verification of the "LuckyDraw" prototype, which demonstrated the creation of a verifiably fair and automated system.

The findings from the quantitative analysis of 100 potential users strongly reinforce this conclusion. The study empirically identified the key drivers for user adoption, revealing that Perceived Usefulness (PU) was the most significant factor influencing users' Behavioral Intention (BIU). This indicates that the tangible benefits offered by the technology namely enhanced transparency and fairness—are the primary motivators for user acceptance. Furthermore, Trust (TRT) was confirmed as the second most critical predictor, highlighting that user confidence in the integrity of the automated smart contract process is paramount. The strong influence of Perceived Ease of Use (PEOU) on Perceived Usefulness also underscores that a simple and intuitive user interface is essential for users to recognize and appreciate the system's core benefits.

The practical implication of this research is significant for developers of decentralized applications. It highlights that technical superiority alone is insufficient for user adoption; the system must be designed to be demonstrably useful, easy to navigate, and capable of building user trust. Theoretically, this study contributes to the academic literature by successfully applying and validating an extended Technology Acceptance Model (TAM) in the specific context of a blockchain-based lucky draw system.

Finally, this research acknowledges its limitations, which in turn open avenues for future work. The prototype's reliance on a centralized owner for key administrative tasks and its use of on-chain pseudo-randomness are primary limitations. Therefore, future research is recommended to explore the integration of decentralized governance models, such as a Decentralized Autonomous Organization (DAO), to manage the lucky draw lifecycle. Additionally, implementing off-chain verifiable randomness solutions, like Chainlink VRF, could further enhance the system's security and fairness for high-stakes applications.

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